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EFFECTS OF PROTECTIVE CLOTHING ON PERSONNEL PERFORMANCE—ANNOTATED INDEX

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This index contains 115 citations on how the wearing of protective clothing affects personnel performance in military land and air operations, and is drawn from classified studies as well as the open literature. Keywords: Military Operations,

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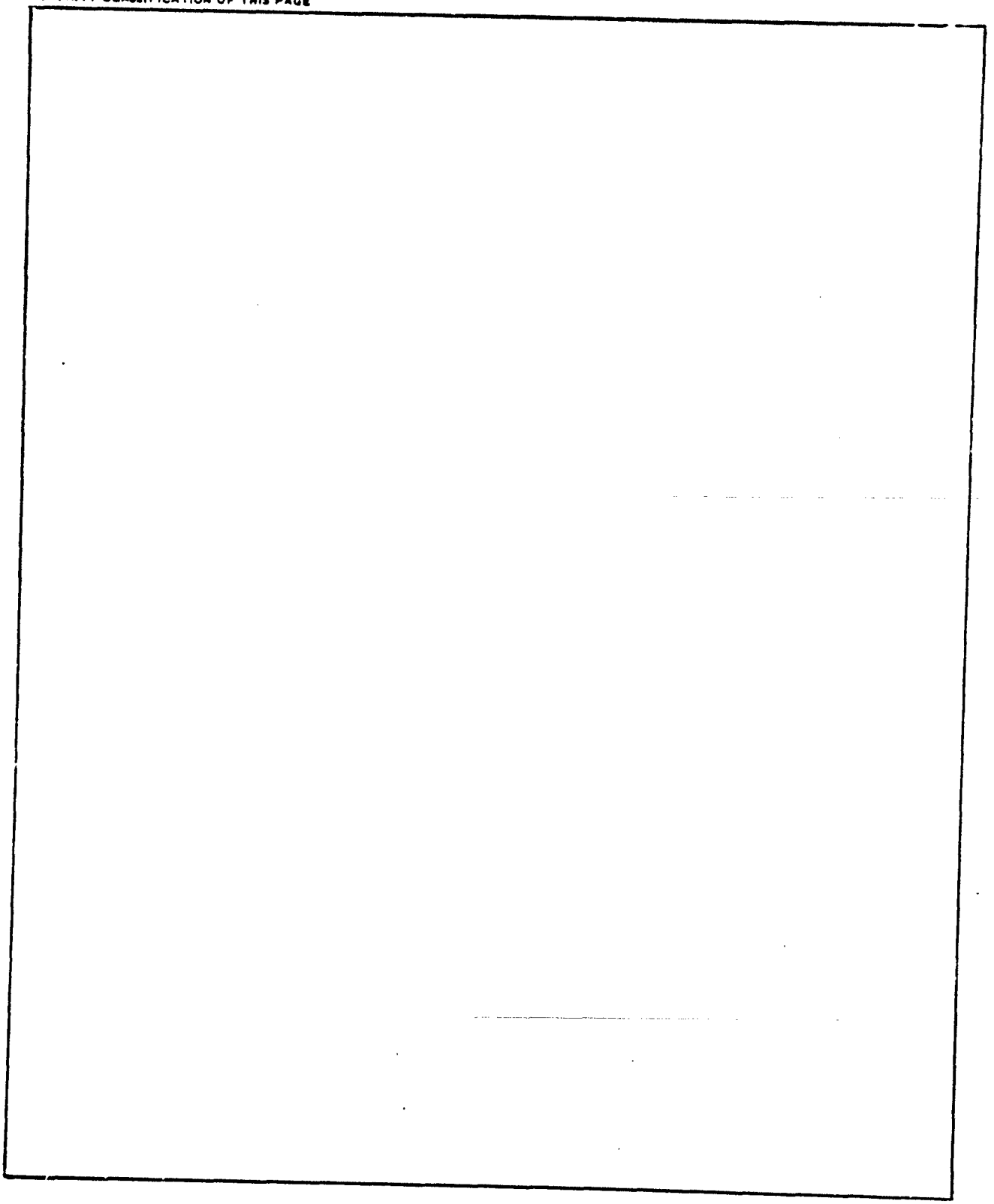

SUMMARY

This review of open literature sources and Department of Defense research gives a good indication of the work that has been performed to ascertain how the wearing of protective clothing affects task performance.

Most research to date has concentrated on how infantry and aircrew perform when required to use protective gear. Far and away, most studies have investigated purely physiological performance degradation, while only a relative few have delved into potential psychological problems. Numerous determinations have been made on the effects of protective clothing in general on overall task performance, and additional research has been directed specifically toward ascertaining the effects of goggles, masks and respirators, and gloves.

Significant recent published literature has originated from the Army Aeromedical Laboratory at Ft. Rucker, Alabama; the Army Combat Developments Experimentation Command at Ft. Ord, California; the Army Human Engineering Laboratory at Aberdeen Proving Ground, Maryland; and from various U.K. establishments, most notably the Army Personnel Research Establishment at Farnborough.

The many studies that detail the rise in body temperature that often accompanies the wearing of protective clothing have not been included here unless they also describe how personnel performance is affected. However, a number of discussions on various means of reducing the thermal stress of personnel are cited in the Appendix.

PREFACE

Citations for all specific indexes contain a 3-digit citation number, title, and date (month-year), and are arranged chronologically from the most recent to the earliest for each index term. The full description of each citation in an index is given in Section 6, Full Citations. This section is arranged numerically by citation number.

Citation availability is given when known in Section 6, Full Citations, where NTIS is the National Technical Information Service, DTIC is the Defense Technical Information Center, and other sources are identified as such.

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FULL CITATIONS

001 TITLE EFFECT OF IMPERMEABLE CLOTHING AND RESPIRATOR ON WORK PERFORMANCE; PT. 1, LABORATORY STUDIES (U), 47 P., (U)
AUTHOR P.B. Mossman and H.A. Atterbom
CORP Sandia Labs. (Albuquerque, NM)
REPORT SAND-77-2132
AVAIL Available from NTIS as N79-11748
DATE 0478
ABSTRACT Work performance with impervious clothing and full-face respirator was investigated during maximal and submaximal (40 to 60%) bicycle ergometer efforts. Such levels would be required of attack teams during an assault on security systems designed to mandate the use of vapor barrier clothing (VBC) and respirators. Five different exercise protocols were administered. Heart rate (HR), oxygen consumption (V/sub O/sub 2//), and skin and rectal temperatures (T/sub s/ and T/sub r/) were monitored. The impervious suits resulted in decreased work performance, aerobic metabolism, and tolerance time. Stress indices of HR and mean T/sub s/ were found to be correlated with these differences. The study demonstrates that a security system using a chemical deterrent places a physiological stress of considerable magnitude on an adversary group. Follow-on field studies have been conducted to relate the conclusions of these laboratory studies to field conditions. The results of the field studies will be reported in Part 2.

002 TITLE EFFECTS OF TEMPERATURE AND PROTECTIVE CLOTHING UPON TASK COMPLETION TIME, WORK QUALITY, AND STUDENT PERCEPTIONS OF THE LEARNING ENVIRONMENT (U), 124 P., (U)
AUTHOR S.R. Burke
CORP U. of Missouri, Columbia
SYMURL Dissertation Abstracts International, Vol. 41/11A, page 4580
DATE 0080
ABSTRACT Much has recently been said about the energy problems facing this country. The literature revealed that most recommendations about optimum cool weather temperatures for vocational laboratories were based upon industrial studies. Some researchers suggested that laboratory temperature may be reduced to 55(DEGREES)F or lower if protective clothing is worn. Others noted that students have their own set of environmental requirements for thermal comfort and may differ from the teacher requirements. The purpose of this study was to ascertain the effects of temperature and protective clothing upon student performance and perceptions toward the learning environment. Hypotheses were: (1) There is no significant difference between group mean task completion times at different laboratory environmental temperatures. (2) There is no significant difference between group mean scores on task completion time for students who wore protective clothing and those who did not at different laboratory environmental temperatures. (3) There is no significant difference between group mean work quality scores at different laboratory environmental temperatures. (4) There is no significant difference between group mean work quality scores for students who wore protective clothing and those who did not at different laboratory enviromental temperatures. (5) There is no significant difference between group mean scores on perceptions toward the learning environment at different laboratory environmental temperatures. (6) There is no significant difference between group mean scores on perceptions toward the learning environment at different temperatures and levels of protective clothing. The study population consisted of students in the 23 schools of the Blue Ridge supervisory area of Virginia that offered the course Agricultural Science and Mechanics I. The sample consisted of 197 students from twelve schools and fifteen classes. A cluster sampling procedure was employed in selecting the sample. Students within each class were randomly assigned to Experimental Group I, Experiment Group II, or Control Group III. After one

day of classroom instruction students were asked to construct a project in the agricultural mechanics laboratory under a randomly assigned temperature of 50(DEGREES)F, 60(DEGREES)F, or 70(DEGREES)F. Group I students constructed the project without protective clothing while Group II students wore coveralls. Group III students performed the same task at a 67(DEGREES)F temperature without protective clothing. Measurements of task completion time, work quality, and perceptions toward the learning environment were taken. The experimental materials were prepared by the researcher. The experiment was a posttest only control group design. One-way and two-way ANOVA and MANOVA procedures were used to analyze the data. A one-way ANOVA was used to analyze the influence of temperature upon task completion time and work quality mean scores, separately. No significant differences were found and hypotheses 1 and 3 were accepted. A two-way ANOVA was used to analyze the influence of temperature and protective clothing upon task completion time and work quality. No significant differences were found among the group mean scores and hypotheses 2 and 4 were accepted. A MANOVA procedure was used on the group mean scores to analyze the influence of temperature and temperature and protective clothing upon perceptions toward the learning environment. Significance was found at the .05 alpha level and hypotheses 5 and 6 were rejected. Based on the findings and limitations of this study, it was concluded that temperature and protective clothing do not influence task completion time and work quality in temperatures as low as 509(DEGREES)F during forty minutes of exposure. However, perceptions toward the learning environment are affected by temperature and temperature and protective clothing. The most favorable perceptions occur at 67(DEGREES)F and 70(DEGREES)F.

003 TITLE EFFECT OF WEARING CHEMICAL PROTECTIVE CLOTHING IN THE HEAT ON SIGNAL DETECTION OVER THE VISUAL FIELD (U)
AUTHOR J.L. Kobrick and L.A. Sleeper
CORP Army Research Institute of Environmental Medicine (Natick, MA)
SYMURL Aviation, Space and Environmental Medicine, 1986 Feb Vol. 57(2)
DATE 0086

004 TITLE PHYSIOLOGICAL STRAIN IN WORK WITH GAS PROTECTIVE CLOTHING AT LOW AMBIENT TEMPERATURE (U)
AUTHOR J. Smolander, V. Louhevaara and O. Korhonen
CORP Institute of Occupational Health, Dept. of Physiology (Vantaa, Finland)
SYMURL Am Ind Hyg Assoc J. 46 (12) Pp. 720-723, ISSN 0002-8894
DATE 1285
ABSTRACT Wearing an impermeable gas protective suit (Drager 500 or 600) and a self-contained breathing apparatus (Drager PA 80; total weight 27 kg (59.5 lb), seven experienced firemen and one mechanic performed simulated repair and rescue tasks in a chemical plant. The subjects' mean (+/-SD) age, height, weight and estimated maximal oxygen consumption were: 36 +/-4 years; 181 +/6 cm; 83 +/-8 kg; and 42 +/-5 mL/min/kg, respectively. The operations took place outdoors (ambient temperature 2.0 degrees C (35.6 degrees F), wind velocity 0-4 m/s). The total work time averaged 37 minutes. During tasks of search, handling vents, and sawing and replacing bolts, the mean (+/-SE) heart rates measured by a Depex recording device were 146 +/-2, 148 +/-2, and 147 +/-5 beats/min, respectively. The mean rectal temperature increased 0.8 degrees C during the whole work period. Weight loss due to sweat averaged 300 g. In conclusion, typical tasks with gas protective clothing caused marked physiological strain among subjects in average physical condition even though the thermal strain was relatively low because the weather was cool. The results emphasized the need to evaluate physical fitness during the periodic check-ups of workers who may have to used gas protective clothing.

005 TITLE FORCE CAPABILITY DIFFERENCE DUE TO GLOVES (U)
AUTHOR D.J. Cochran and C.A. Schanbacher
ORIGIN England
SYMURL Ergonomics (ENGLAND), Feb 1985, 28 (2) Pp. 441-447, ISSN 0014-0139
DATE 0285

006 TITLE REDUCTION OF ISOMETRIC MUSCLE ENDURANCE AFTER WEARING IMPERMEABLE GAS PROTECTIVE CLOTHING (U)
AUTHOR J. Smolander, V. Louhevaara, T. Tuomi, O. Korhonen and J. Jaakkola
SYMURL Eur J Appl Physio, 1984, 53 (1) Pp. 76-80, ISSN 0301-5548
DATE 0084
ABSTRACT The isometric endurance of forearm muscles at 40% maximum voluntary contraction was measured in six healthy male subjects, after they had walked for 25-30 min on a treadmill while wearing an impermeable gas protective suit and a self-contained breathing apparatus at a light (21% V02 max), and a moderate 41% V02 max) work level. The mean endurance times were 12% (NS) and 24% (P less than 0.01) shorter than the average control value after exercise for the light and moderate work levels, respectively. These changes were accompanied by an increased heart rate, and rectal and skin temperatures. Ventilating the suit with an air flow of 181 . min-1 at the moderate work level did not sign ficantly affect isometric endurance (decreased 27%), heart rate or body temperatures. It was concluded, that muscular performance capacity is reduced after wearing gas-protective clothing in a temperate environment, presumably due to the increased muscle temperature, and this should be considered in scheduling work times and rest periods.

007 TITLE PHYSIOLOGICAL EFFECTS ON WORK PERFORMANCE ON VAPOR-BARRIER CLOTHING AND FULL-FACE RESPIRATOR (U)
AUTHOR H.A. Atterbom and P.B. Mossman
SYMURL J Occup Med, 1978 Jan, 20 (1) Pp. 45-52, ISSN 0096-1736
DATE 0178
ABSTRACT Work performance with impervious clothing and full-face respirator was investigated during maximal and submaximal (40-60%) bicycle ergometer efforts. Such levels may be dictated by the requirements of emergency deconcontamination tasks while most studies have been concerned with lower levels of activity. Five different exercise protocols were administered. Heart rate (HR), oxygen consumption (Vo2), skin (Ts) and rectal (Tr) temperatures were monitored. The impervious suits results in decreased work performance, aerobic metabolism, and tolerance time. Stress indices or HR and mean Ts were found to be correlated with these differences. The study is being expanded for the purpose of establishing safe physiological guidelines for work tolerances at higher energy levels in impermeable suits.

008 TITLE SELECTED FACTORS AFFECTING AIRCREW PERFORMANCE DURING SUSTAINED OPERATIONS (U), 17 P., (U)
AUTHOR K.A Kimball
CORP Army Aeromedical Research Lab., Biomedical Applications Research Lab. (Ft. Rucker, AL)
AVAIL Available from NTIS as N84-21074; Available from DTIC as AD P002990; Available from AIAA Technical Library
SYMURL AGARD Conference, Sustained Intensive Air Operations (See Item 015 [NTIS N84-21062; DTIC AD A139324]); PP. 20-1--20-17
DATE 1183
ABSTRACT Six graduates of initial rotary wing training flew a UH-1H helicopter for up to 4 hours while wearing each of clothing ensembles. Each aviator wore the standard flight suite, the US chemical defense (CD) ensemble, and the United Kingdom (UK) CD ensemble in hot weather (mean WBCT 29 C). Skin temperatures (chest, thigh, upper arm, and calf) rectal temperature, heart rate, and preflight and postflight body weights were recorded. Cognitive testing was conducted preflight, postflight, and on

nonflight days. Aviator performance measures were also obtained during flight. Well acclimatized aviators were able to fly at least 2 hours without serious physiological impairment. Three of the six aviators terminated flight for medical reasons (heart rates 40 bpm or nausea) while wearing the US ensemble. The susceptible subjects tended to be older and heavier. Heart rate was judged to be the most sensitive indicator of heart stress. Cognitive testing and flight performance data obtained during this exercise did not demonstrate changes as a function of the type of flight ensemble worn during the test, nor did flight performance serve as a predictor of heart stress.

009 TITLE THERMAL CONTROL PROBLEMS IN MILITARY HELICOPTERS (U), 10 P., (U)
AUTHOR J.R. Allan
CORP Royal Air Force Institute of Aviation Medicine (Farnborough, [England])
ORIGIN United Kingdom
AVAIL Available from NTIS as N84-26286; Available from AIAA Technical Library
SYMURL AGARD Conference, Aeromed. Support in Mil. Helicopter Operations (NTIS N84-26279)
DATE 0484
ABSTRACT The origins of thermal problems in military helicopters are discussed and compared with those of fixed wing aircraft. Some typical helicopter sortie temperature profiles are presented for hot and cold environments. The environments for protection from chemical warfare agents are described in relation to helicopter operations and the additional thermal problems arising from chemical protective assemblies and drills are described. Potential adverse effects on aircrew performance and fatigue are considered. Thermal hazards in post crash survival situations are also considered particulary those related to ditching in cold water. Various approaches to the relief of thermal stress in helicopter aircrew are considered. The limitation of engine powered environmental control systems and the potential advantages of personal conditioning systems are described. The advantages of liquid conditioned systems are compared with air systems. Cold environment protection is described in terms of insulation and water exclusion and the role of electrically heated garments is described.

010 TITLE IDENTIFICATION OF AN APPREHENSION EFFECT ON PHYSIOLOGICAL INDICES OF THERMAL STRAIN (flight protective clothing evaluation) (U)
AUTHOR M.H. Harrison and C. Saxton
CORP RAF, Institute of Aviation Medicine (Farnborough, Hauts., England)
ORIGIN United Kingdom
AVAIL Available from AIAA Technical Library
SYMURL Aviation, Space, and Environmental Medicine, Vol. 47, Sept 1976, Pp. 950-953
DATE 0976
ABSTRACT Experiments were conducted on eight male subjects aged 24-37 yr to evaluate the additional thermal strain produced when a protective clothing assembly (PCA) was worn in addition to a normal flying clothing assembly (FCA)> The experimental design adopted involved condition replication, i.e., each subject in the evaluation took part in two 'control' (FCA only) and two 'test' (FCA+PCA) experiments. The measurements concerned climatic factors, deep body temperature, skin temperature, and heart rate. The data were analyzed by analyses of variance of the absolute values of each physiological measure, and also in increments above the mean of steady-state measurements made during the last 15 min of the rest period. It is shown that condition replication revealed a significant apprehension effect which confounded the physiological variables used to evaluate the thermal strain, leading to an overestimation of the severity of thermal strain. In addition, there was a large between-subject variation among the eight subjects, which made the arithmetic mean a potentially

misleading statistic for evaluating the increased physiological strain caused by PCA during heat exposure.

011 TITLE DESIGN OF WORKING SYSTEMS ON ERGONOMIC PRINCIPLES. THE IMPORTANCE OF CLOTHES AND PROTECTIVE EQUIPMENT IN THE DESIGN OF THE WORKPLACE (U), 7 P., (U)
REPORT HSE-TRANS-10865; DIN-33-400-SUPPL-7; FNERG-AA-10-30A-77; FNERG-AA-2-14A-77
ORIGIN Federal Republic of Germany
AVAIL Available from AIAA Technical Library
SYMJRL Transl. into English from Deut. Inst. fuer Normung (West Germany), Vol. 33 No. 400 Suppl. 7, Aug. 1977, 7 p.
DATE 0585
ABSTRACT Those criteria which determine the effects of clothing and protective equipment on body dimensions, the changes in center of gravity due to protective gear, the effects of this equipment on performance and on the risk of accident are discussed.

012 TITLE PREDICTION OF AIRCREW PERFORMANCE UNDER DIFFERENT ENVIRONMENTAL CONDITIONS (U), 9 P., (U)
AUTHOR E.H. Wissler and S.A. Nunneley
CORP Texas U. (Austin TX) and AF School of Aerospace Medicine (Brooks AFB, TX) N
REPORT SAE Paper 840939
AVAIL Available from AIAA Technical Library
SYMJRL 14th Intersociety Conference on Environmental Systems, July 16-19, 1984, San Diego, CA
DATE 0784
ABSTRACT If thermal problems are to be avoided in both military and commercial aviation, a rational procedure is required for evaluating the effect of various environmental parameters on the condition of aircrew members. In this paper, the authors describe a computer model which has been shown to predict accurately human thermal responses over a wide range of conditions. The model allows one to evaluate the effect on aircrew members of important parameters, such as the work profile, regional and temporal variation in windspeed, temperature, and solar load, and the type of garment worn. It is also possible to simulate the use of liquid cooled garments to reduce thermal stress, and the effect of immersion in cold water. Representative applications involving three different situations are presented in the paper.

013 TITLE EVALUATION OF OLEFIN ANTI-EXPOSURE LINERS FOR THEIR EFFECTS ON THE OPERATIONAL PERFORMANCE AND SURVIVAL OF NAVAL AIRCREWMEN (U)
AUTHOR S.M. Reeps and J.W. Kaufman
CORP Naval Air Development Center, Aircraft and Crew Systems Technology Directorate (Warminster, PA)
AVAIL Available from AIAA Technical Library
SYMJRL SAFE Journal, Vol. 15, Spring 1985, Pp. 22-28
DATE 0085
ABSTRACT Olefin anti-exposure liners, worn as part of a constant wear antiexposure assembly, have been evaluated at the Naval Air Development Center to determine their levels of performance in the areas of mobility/reach, heat stress/comfort, and immersion hypothermia protection. Mobility/reach measurements were made using an anthropometric measuring device specifically constructed to measure movements required of aircrewmen operating aircraft. Heat stress testing consisted of three hour exposure in 35 C air while subjects repeated a 20-minute cycle of work, psychomotor tracking, and rest. Immersion hypothermia testing was conducted in 7.2 C water, 0 C air, and 24-32 kph winds, with maximum exposure time set at two hours. Two liner configurations, differing in the extent of body-extremity coverage, were evaluated and compared to the current CWU-23/P Anti-exposure liner. Both configurations are fabricated of 100 percent olefin--microfiber insulation sandwiched between layers of woven high--

temperature resistant aramid fabric for fire protection. The results are discussed in terms of the U.S. Navy Operational Requirement for cold water protection, as currently specified by CNO. A review of related evaluations conducted at other facilities is also provided and discussed.

014 TITLE LABORATORY STUDIES OF AIRCREW CHEMICAL PROTECTIVE ENSEMBLE: EFFECTS ON PILOTS' PERFORMANCE (U), 18 P., (U)
AUTHOR G.R. McMillan, W.J. Cody and R.G. Mills
CORP McDonnell-Douglas Astronautics (Huntington Beach, CA) and Aerospace Medical Research Labs., Human Engineering Div. (Wright-Patterson AFB, OH)
AVAIL Available from NTIS as N84-21066; Available from DTIC as AD P002984; Available from AIAA Technical Library
SYMURL AGARD Conference, Sustained Intensive Air Operations (See Item 015 [NTIS N84-21062; DTIC AD P002983]); Pp. 7-1--7-18
DATE 0083
ABSTRACT The results of a U.S. Air Force program designed to quantify the effects of current and near-term chemical protective gear on pilot performance are described. The first phase of the program consisted of a sensitivity analysis to determine which aspects of pilot performance should be evaluated, the anticipated performance decrements, the stress mechanisms presumed to be operating, and the flight simulations required to quantify the effects of the protective ensemble. To date, two full-mission laboratory experiments have been completed. These experiments evaluated the currently fielded USAF aircrew ensemble and a proposed Integrated Chemical Defense System. Reductions in pilot performance were observed with both systems under simulated hot environmental conditions. However, the pilots strongly preferred the Integrated Chemical Defense System's eye-respiratory protective gear. The data suggest that thermal stress, produced by the multiple layer body protective gear, caused the performance reductions. The experimental data are being further analyzed with appropriate mission and effectiveness models.

015 TITLE SUSTAINED INTENSIVE AIR OPERATIONS: PHYSIOLOGICAL AND PERFORMANCE ASPECTS (U), 220 P., (U) (Conference held in Paris, 18-22 Apr 1983)
CORP Advisory Group for Aerospace Research and Development (Neuilly-SurSeine, [France])
REPORT AGARD-CP-338; ISBN-92-835-9343-0
ORIGIN France
LANG English $ French
AVAIL Available from NTIS as N84-21062; Available from AIAA Technical Library
DATE 1183
ABSTRACT The symposium addressed the aeromedical and human factors aspects of the capabilities of aircrew and ground crew to perform their duties at high intensities at irregular times of the day and night over many days or weeks under military operational conditions. Laboratory studies on the measurement of aircrew workload, the effects of disturbances of circadian rhythms and deprivation of sleep and the use of hypnotics and stimulants to influence sleep and wakefulness are reported. The effects of protective equipment and procedures on air and ground crew with particular reference to fast jet and helicopter operations are examined. Field studies of fatigue, performance and physiological disturbances in aircrew and ground personnel engaged in sustained air operations are described. For individual titles, see N84-21063 through N84-21081

016 TITLE MISSILE COMPONENT REPAIR WHILE WEARING NBC PROTECTIVE CLOTHING (U), 50 P., (U)
AUTHOR J.D. Waugh and P.W. Kilduff

CORP Human Engineering Labs. (Aberdeen Proving Ground, MD)
REPORT HEL-TM-1-84
AVAIL Available from NTIS as N84-20180; Available from DTIC as AD A137315; Available from AIAA Technical Library
DATE 0184
ABSTRACT The US Army Human Engineering Laboratory assessed possible degradation in the performance of missile repair persons while wearing NBC protective clothing. Nine male soldiers, just graduated from the Advanced Individual Training Course in Missile Repair, were required to perform repair tasks in three replications. Two repair tasks were chosen; one considered nondifficult whose activities concentrated on procedural diagnostics and fault isolation; the second considered difficult, required manipulaitng small machine parts and hand tools requiring fine eye-and coordination. The experimental results and subsequent comparative statistical analysis showed no degradation in performance of the easier procedures and diagnostic task. The time to complete the more difficult task was degraded (increased) on the average of 45% in MOPP 4 with a definite contribution to degradation attributed to the mask/hood and the protective gloves by themselves. A significant improvement attributed to learning from the first to the second presentation was found, but not from the second to the third presentation. The participants' degree of learning was neither enhanced nor held back while in protective clothing compared to working in the duty uniform.

017 TITLE PSYCHOLOGICAL MEASUREMENTS DURING THE WEAR OF THE US AIRCREW CHEMICAL DEFENSE ENSEMBLE (U), 54 P. (U)
AUTHOR B.E. Hamilton and L. Zapata
CORP Army Aeromedical Research Lab., Biomedical Applications Research Div. (Ft. Rucker, AL)
REPORT USAARL-83-7
AVAIL Available from NTIS as N83-28872; Available from DTIC as AD A125616; Available from AIAA Technical Library
DATE 0283
ABSTRACT The psychological (as opposed to physiological) effects of wearing a US aircrew chemical defense ensemble were evaluated using 12 male and 12 female volunteers. Half of the males and half of the females wore chemical defense ensembles while the rest wore standard US flight suits as controls. All subjects were administered tests of cognition (math, logical reasoning, target detection,, and reaction time) before and after 6 hours of wear in a controlled environment. In addition, subjects rated their mood before and after wear. It was concluded that wearing the ensemble in an undemanding environment degraded affect (mood and activation levels), slightly decreased accuracy, and substantially decreased reaction times, especially in females. The most serious impact of the ensemble would seem to be a decrease in morale in females.

018 TITLE RESTRAINT BY CLOTHING UPON FIRE-FIGHTERS PERFORMANCE (U)
AUTHOR E.J.G. Vandelinde
CORP Institute for Perception RVO-TNO, Soesterberg (Netherlands)
ORIGIN Netherlands
AVAIL Available from NTIS as N83-26472; Available from AIAA Technical Library
SYMJRL Research Inst. of National Defense Intern. Conf. on Protective Clothing Systems, Pp. 195-204 (NTIS N83-26454)
DATE 0183
ABSTRACT Physiological strain caused by metabolic and environmental heat and fire protective clothing was studied. Six subjects performed light work on a treadmill in two different climates, wearing three different types of clothing. For each of the resulting 36 sessions heat balance was reconstructed and clothing parameters were calculated. Measurements show little difference in insulation but large differences are found in water vapor permeabi-

lity, ranging from 0.11 to 0.25. Poor permeability results in high heat strain, especially during moderately hot work or recovery periods. Predictions of tolerance time during a moderately not fire trail are shorter than measured. Differences in tolerance time between clothing are predicted correctly. A diagram that displays safe work time as a function of metabolic and environmental heat load is proposed.

019 TITLE PERFORMANCE IMPACT OF CURRENT UNITED STATES AND UNITED KINGDOM AIRCREW CHEMICAL DEFENSE ENSEMBLES (U), 44 P., (U)
AUTHOR B.E. Hamilton, D. Folds and R.R. Simmons
CORP Army Aeromedical Research Lab., Biomedical Applications Research Div. (Ft. Rucker, AL)
REPORT USAARL-82-9
AVAIL Available from NTIS as N83-20570; Available from DTIC as AD A121502; Available from AIAA Technical Library
DATE 0982
ABSTRACT The ability of helicopter pilots to fly while wearing chemical defense (CD) ensembles in hot weather was investigated. Each subject flew on three separate days, wearning a different ensemble each day. The ensembles tested were the United States Army Aircrew chemical defense ensemble, the United Kingdom aircrew chemical defense ensemble, and the United States Army standard flight suit uniform. While subjects made statistically larger heading errors while wearing the US chemical defense ensemble, no operationally significant differences in performance were seen. It is concluded that a pilot's performance is not an indicator of heat stress.

020 TITLE PHYSIOLOGICAL IMPACT OF WEARING AIRCREW CHEMICAL DEFENSE PROTECTIVE ENSEMBLES WHILE FLYING THE UH-1H IN HOT WEATHER (U), 84 P., (U)
AUTHOR F.S. Knox III, G.A. Nagel, B.E. Hamilton, R.P. Olazabal and K.A. Kimball
CORP Army Aeromedical Research Unit, Biomedical Applications Research Div. (Ft. Rucker, AL)
REPORT USAARL-83-4
AVAIL Available from NTIS as N33-18255; Available from DTIC as AD A121581; Available from AIAA Technical Library
DATE 1082
ABSTRACT Six recent graduates of initial entry rotary wind training flew a UH-1H for up to 4 hours while wearing each of three clothing ensembles. Each aviator wore the standard flight suit, the US chemical defense (CD) ensemble, and the United Kingdom CD ensemble in heat weather (mean WBGT 29 C). Skin temperatures (chest, thigh, upper arm and calf), rectal temperature, heart rate, and preflight and postflight body weights were recorded. Three of six aviators terminated flight for medical reasons (heart rates > 140 bpm of nausea) while wearing the US ensemble. Well acclimatized aviators in this study who did not preflight and drank water every hour were able to fly for at least 2 hours (one fuel load) before the most susceptible subjects had to terminate flight due to heat stress. Heart rate was the most susceptible subjects nad to terminate flight due to heat stress. Heart rate was the most sensitive indicator of this stress. In this study, these susceptible subjects tended to be older and heavier. Although no measures cardiopulmonary fitness (e.g., V sub O2 max) were made, it may be that these susceptible subjects were somewhat less fit. The US ensemble was somewhat more stressful than the UK or standard ensembles. Subjectively all subjects preferred the AR5 respirator to the M24 mask, were divided on overgarment vs undergaremnt, and most disliked the US overboots. As a caveat it should be stated that fitness alone is not likely to be sufficient to overcome the heat stress induced by these ensembles as flight times are extended. Some sort of cooling will probably be needed.

021 TITLE PHYSIOLOGICAL RESPONSES OF HUMAN SUBJECTS WEARING THERMAL PROTECTIVE CLOTHING ASSEMBLIES IN VARYING ENVIRONMENTS (U)
AUTHOR D.C. Johanson, S.M. Reeps and L.J. Santamaria
CORP Naval Material Command, Naval Air Development Center (Warminster, PA)
SYMJRL Proceedings of the Survival and Flight Equipment Association 17th Annual Symposium, Dec 2-6, 1979 held at Las Vegas, NV
DATE 0080
ABSTRACT A group of representative free world anti-exposure suit configurations was selected for a test program designed to evaluate their relative effects on aviator performance in the areas of mobility loss, heat stress, and immersion hypothermia protection. Sequential testing was utilized to eliminate those configurations which did not meet predetermined requirements to satisfy the operational need of naval forces. Mobility loss and heat stress testing at 35 C have been completed. Immersion hypothermia testing in 7.2 C water is currently being conducted with tests in 0 C water to follow.

022 TITLE THERMAL AND ACCELERATION EFFECTS ON AIRCREW MEMBERS IN CHEMICAL DEFENSE GEAR (U), 36 P., (U)
AUTHOR R.E. Yates, C.R. Replogle and J.H. Veghte
CORP Aerospace Medical Research Labs. (Wright-Patterson AFB, OH)
REPORT AFAMRL-TR-79-71
AVAIL Available from NTIS as N80-30045; Available from DTIC as AD A086026
DATE 0180
ABSTRACT An experiment was conducted to determine the combined thermal and acceleration effects on aircrew members in chemical defense protective gear in a simulated air-to-ground mission. The subject flew two sorties per day in the Dynamic Environment Simulator. The environmental conditions simulated were typical of a 95th percentile hot summer central European day. Most of the responses seen in the subject can be attributed to the thermal stress caused by the hot temperatures and the heavy protective clothing.

023 TITLE PATIENT CARE IN A CHEMICAL ENVIRONMENT SUB-STUDY: EFFECTS OF CHEMICAL PROTECTIVE CLOTHING ON THE PERFORMANCE ON BASIC MEDICAL TASKS (U), 52 P., (U)
AUTHOR J.M. King and A.J. Frelin
CORP Army Health Care Studies and Clinical Investigation Activity, HCS Div. (Ft. Sam Houston, TX)
REPORT HCSD-83-001
AVAIL Available from DTIC as AD A139001
DATE 1282
ABSTRACT The purposes of this study were (1) to measure the ability of medical specialists to perform 9 selected basic medical tasks while in fatigue uniform, MOPP-4, or MOPP-4 with a tactile glove, (2) to measure learning effects on performance of these tasks, (3) to determine the degree of which the ability to perform the tasks is degraded by MOPP-4 or MOPP-4 with the tactile glove, and (4) to obtain preliminary durability and user satisfaction data on the tactile glove. Subjects performed the tasks in fatigues, MOPP-4 with tactile glove, and MOPP-4 for six consecutive duty days, thus each subject served as his/her own control. Subjects were able to perform all of the tasks under all conditions on all test days. Subjects improved their performance speed significantly, while making fewer errors. The bulk of the improvement in performance occurred in the first 3-4 days of the study in fatigues, MOPP with tactile gloves, and MOPP-4. At the end of the study, subjects functioned at 77% of fatigue level in MOPP with tactical gloves and at 64% of fatigue level in MOPP-4. It may be advisable to alter manning patterns in order to maintain work output. Tactical gloves significantly improved performance, but have relatively low durability, with

15 of 18 damaged by the end of the study. They are of considerable value for tasks which require the extra dexterity.

024
TITLE FIREFIGHTERS INTEGRATED RESPONSE EQUIPMENT SYSTEM (U), 11 P., (U)
AUTHOR H. Kaplan and F. Abeles
CORP Grumann Aerospace Corp. (Bethpage, NY)
REPORT ASME Paper 78-ENAS-39
AVAIL Available from AIAA Technical Library
SYMJRL American Society of Mechanical Engineers, Intersociety Conference on Enviornmental Systems, July 10-13, 1978, San Diego, CA
DATE 0778
ABSTRACT The firefighters Integrated Response Equipment System (Project FIRES) is a joint National Fire Prevention and Control Administration (NFPCA)/National Aeronautics and Space Administration (NASA) program for the development of an 'ultimate' firefighter protection against hazards, such as heat, flame, smoke, toxic fumes, moisture, impact penetration, and electricity and, at the same time, improve firefighter performance by increasing maneuverability, lowering weight, and improving human engineering design of his protective ensemble.

025
TITLE EFFECTS OF ENCUMBERING CLOTHING, PERSONAL-PROTECTIVE EQUIPMENT AND RESTRAINTS ON BODY SIZE AND ARM-REACH CAPABILITY OF USAF AIRCREWMEN (U), 4 P., (U)
AUTHOR M. Alexander, L.L. Laubach and J.T. McConville
CORP Webb Associates (Yellow Springs, OH)
REPORT AMRL-TR-76-118
AVAIL Available from NTIS as N77-28746; Available from DTIC as AD A036682; Available from AIAA Technical Library
SYMJRL Presented at the Aerospace Med. Assoc. Meeting, Bal. Harbour, FL, 10-13 May 1976
DATE 0576
ABSTRACT Basic anthropometric dimensions provide engineers and designers with data on the range of body size variability that must be accommodated in the design and development of clothing, personal-protective equipment and workspaces. Designers of cockpits and similar workspaces must also be cognizant of the growth in body size associated with various configurations of clothing and personal-protective equipment and the effects of these assemblies on performance of the users. A study of a stratified sample of 32 USAF pilots wearing their operational assemblages of over-land and over-water flight gear and equipment was conducted. The study determined changes in critical workspace dimensions and arm and leg reach performance due to encumberments of the clothing and equipment. The results of the investigation indicated changes occurred both in body size and performance which were of significance to designers.

026
TITLE AIRCREW PROTECTIVE CLOTHING AND DEVICES SYSTEM (FIGHTER/ATTACK AIRCRAFT) (U), 49 P., (U)
AUTHOR S.J. Winsko and A.S. Hellman
CORP Naval Air Development Center, Crew Systems Dept. (Warminster, PA)
REPORT NADC-75294-40
AVAIL Available from NTIS as N77-20780; Available from DTIC as AD A031566
DATE 1275
ABSTRACT A study was conducted to portray the major mission profiles in which the Fighter/Attack community is engaged and by so doing, to identify the problem areas associated with the current inventory of Fighter/Attack Aircrew Protective Equipment toward fulfilling the requirements of these missions. The ultimate objective of this effort is to provide a sound basis from which a series of separate but coordinated engineering developments will be conducted to provide a new generation of mission-oriented protective systems for the Fighter/Attack community. The net effect of this program will be to enhance the inflight

performance and effectiveness of all Fighter/Attack aircrewmen with little or no sacrifice to their safety in the event of an emergency situation.

027 TITLE REDUCTION OF ISOMETRIC MUSCLE ENDURANCE AFTER WEARING IMPERMEABLE GAS PROTECTIVE CLOTHING (U)
AUTHOR J. Smolander, V. Louhevaara, T. Tuomi, O. Korhonen and J. Jaakkola
CORP Inst. Occupat. Hlth. Dept. Physiol. (Helsinki/Finland)
SYMURL European, Journal of Applied Physiology and Occupational Physiology, V53, N1, P.76-80
DATE 0084

028 TITLE INDIVIDUAL FACTORS IN THE CHOICE OF RESPIRATORY PROTECTIVE DEVICES (U)
AUTHOR W.S. Beckett and C.E. Billings
SYMURL American Industrial Hygiene Association Journal, Vol. 46 No. 5, May 1985, Pp. 274-276
DATE 0585
ABSTRACT Safety considerations and physical and physiological factors in the choice of occupational respiratory protective devices are reviewed. In work environments where a risk of toxic inhalation exposure exists, respiratory protective devices are required when engineering controls cannot provide adequate protection. Choice of a respirator requires thorough knowledge of the requirements of the job, and a medical history and physical examination of the worker. It is pointed out that respiratory protective devices have been engineered to permit porolonged use at high workloads by healthy young males without producing adverse physiologic consequences. Since all respirators interfere with speech, hearing, vision, mobility, or some combination of these, a respirator must be chosen which does not interfere with any essential of work safety. Space limitations of the work environment should be considered. Fit testing is recommended for comfort and protection. Problems with glasses or contact lenses, dentures, facial hair, prior neck or face survery, and a variety of skin diseases are considered. Physiological factors to be considered include individual alterations of ventilation with increased work loads and added cardiovascular stress. Variability in the threshold of perception of the respiratory load and the magnitude estimation of inspiratory resistance affect worker acceptance of the protective devices. Added cardiovascular stress due to respirators which add considerable weight is also discussed. The authors conclude that careful consideration must be given to the individual worker, the work environment, the requirements of the job, and the particular characteristics of the device in choosing a respiratory protective device.

029 TITLE BIOPSYCHOLOGICAL RESPONSES OF MEDICAL UNIT PERSONNEL WEARING CHEMICAL DEFENSE ENSEMBLE IN A SIMULATED CHEMICAL WARFARE ENVIRONMENT (U)
AUTHOR B.J. Carter and M. Cammermeyer
SYMURL Military Medicine, Vol. 150 No. 5, Pp. 239-249
DATE 0585
ABSTRACT A study of biopsychological responses of soldiers to wearing chemical warfare defense gear was conducted. Questionnaires pertaining to biopsychological symptoms were administered to 105 personnel of an Evacuation Hospital, Oakland Army Base, California, after they participated in a training exercise wearing chemical warfare protective gear designed for Mission Operated Protective Posture. This gear represented the highest degree of protection in a chemical environment and consisted of an over garment, mask with hood, over boots, and gloves. Ninety nine questionnaires were returned. Fifty five of the respondents were females. The subjects ranged in age from 17 to 58 years. The ethnic background of the subjects included: AfroAmerican, 32.9 percent; Caucasian, 50.55 percent; Asian/American, 0.89 percent;

and Hispanic/American, 6.59 percent. Seven subjects did not wear the gear through the exercise. Of these, four terminated the exercise due to hyperventilation, claustrophobia, dizziness, headache, or inability to tolerate the mask. Three subjects terminated due to difficulty with the gear. Of those completing the exercise, 69 subjects reported at least one biopsychological response. The most frequently reported responses were rapid breathing, shortness of breath, loss of side vision, sweating, visual disturbances, anxiety, and claustrophobia. The mean number of responses reported per subject was 3.725, with females reported 3.977 mean responses and males, 3.308. About half of the subjects reported difficulty with the protective equipment. More non Caucasians than Caucasians reported have difficulty with the equipment. Ethnic background was not significantly correlated with number of responsesreported. The authors suggest that the responses could be attributed to physical effort

030 TITLE REDUCTION OF ISOMETRIC MUSCLE ENDURANCE AFTER WEARING IMPERMEABLE GAS PROTECTIVE CLOTHING (U)
AUTHOR J.V. Smolander, V. Louhevaara, T. Tuomi, O. Korhonen and J. Jaakkola
SYMJRL European Journal of Applied Physiology, Vol. 53 No. 1, Pp. 76-80
DATE 0984
ABSTRACT Muscle endurance after wearing gas protective clothing was investigated. Six health volunteers underwent clinical stress tests, anthropometric measurements, and determinations of maximum oxygen consumption and anaerobic threshold. The subjects walked at 21 and 41 percent of maximum oxygen consumption work levels on a treadmill, wearing 25 kilograms of an impermeable gas protective suit. The isometric strength of the subjects was measured using the maximum voluntary contractions of their hand grips. During light and moderate walks in unventilated suits, oxygen consumption averaged 14.7 and 27.6 millimeters per minute per kilogram, respectively, and heart rate reach 120 and 167 beats per minute, respectively. The wearing of gas protective clothing caused significant increases in rectal and skin temperatures over comparisons doing the same work. At low work levels, the isometric muscle endurance decreased 12 percent after wearing protective clothes, and decreased by 24 percent at high work levels. The authors conclude that the wearing of impermeable gas protective clothing, even with ventilation, causes a decrease in isometric muscle endurance, probably by an effect of the increased temperature of the contracting muscles.

031 TITLE PHYSICAL EXERCISE AND INDUSTRIAL RESPIRATORS (U)
AUTHOR M. van Putten, F. Verstappen and L. Bloemen
SYMJRL International Journal of Sports Medicine, Vol. 5, Pp. 13-14
DATE 1184
ABSTRACT The effects of industrial inspiratory pressure respirators on breathing and circulation during exercise were compared with those on negative inspiratory pressure respirators. Fire fighters experienced in respirator use and athletes without experience with respirators used either system or no respirator while using a bicycle ergometer at up to 80 percent of maximum oxygen intake until exhaustion or while walking on a treadmill with protective clothing and respirator equipment. The highest work load achieved, heart rate, respiration rate, 1 minute ventilation, oxygen uptake, and blood lactate concentrations were determined for each trial. No effect of either respirator was seen on work load achieved, heart rate, or maximum blood lactate concentrations. No effect of respirators were seen during submaximal effort. There was a difference in working capacity, expressed as oxygen uptake, between the trained athletes and the fire fighters but this was not affected by either respirator type. In most cases there was no effect of the type of exercise. Although for some subjects the physiological results of the two exercises were quite different, no effect of the respirators was

seen. The authors conclude that neither respirator type has significant effect on body function during exercise. Experience in using the respirators appears not to be a factor in performance. Specificity of the work performed can affect the results and should be considered.

032 TITLE PSYCHOLOGICAL REACTIONS DURING CHEMICAL WARFARE TRAINING (J)
AUTHOR F.R. Brooks, D.G. Ebner, S.N. Xenakis and P.M. Balson
SYMJRL Military Medicine, Vol. 148 No. 3, Pp. 232-235
DATE 0383
ABSTRACT Psychiatric symptons occurring during a combat field exercise for chemical warfare training were studied. In simulations designed to test medic triage and emergency treatment of casualties in a chemical environment, mock casualties and trained combat medics wore chemical protective gear. Smoke was generated to simulate gas attack. The protective gear included mask, coat, trousers, gloves, and boot covers. Psychological symptoms and behavioral problems were recorded in participants by a project officer assigned to monitor each group. Psychological symptoms were detected immediately after the start of the exercise and throughout its course. Three of the 70 participants experienced symptons sufficiently debilitating to cause them to end participation. They reported panic immediately and showed hyperventilation, confusion and visual distortion. Three other participants experienced early symptoms but were able to continue with reassurance. Eight other subjects experienced difficulties in the later portions of the test, with poor judgement in problem solving and dyspnea, visual blurring, confusion and fear. The authors conclude that in this situation there was at least a 20 percent incidence of psychological reactions with gross symptoms. Very few of the soldiers had worn the protective gear before and none had worn it while performing combat tasks in a chemical environment. They recommend development of prevention strategies such as simulation, modeling, self management and inoculation training. Soldiers should practice as a soldier and as a casualty. Secondary prevention strategies should include training to reassure self or companions, with the medic considered a resource for the affected soldier.

033 TITLE IMPACT OF THE CHEMICAL PROTECTIVE ENSEMBLE ON THE PERFORMANCE OF BASIC MEDICAL TASKS (U)
AUTHOR J.M. King and A.J. Frelin
SYMJRL Military Medicine, Vol. 149 No. 9, Pp. 496-501
DATE 0984
ABSTRACT The ability of military medical specialists to perform field tasks while subjects wore fatigues, Mission Oriented Protective Posture (MOPP) gear, or MOPP gear with a prototype glove designed to improve tactile sensitivity was investigated. Eight tasks requring dexterity and coordination were chosen. They were: administration of emergency care to a chemical agent casualty or first aid to a patient with a sucking chest wound; initiation of field card or intravenous infusion; application of a splint to a fractured lower extremity or application of a tourniquet; immobilization of a fracture; and application of field first aid dressing. Performance decreased with MOPP gear and MOPP gear plus gloves, which required 53 and 29 percent more time, respectively, than did performance in fatigues. Performance improved with time. The gloves had low durability; 15 ot 18 gloves had flaws by the end of the 6 days. Improvement in cuff design was suggested. Subjects reported that they did not feel comfortable wearing the gloves in a contaminated environment. The authors suggest that the number of personnel be increased in situations where MOPP gear and MOPP gear with tactile gloves are used. However, tasks can be performed while wearing MOPP if troops are trained.

034 TITLE INFLUENCE OF WEIGHT OF PERSONAL PROTECTIVE EQUIPMENT ON THE FUNCTIONAL STATUS OF THE BODY DURING PHYSICAL WORK IN VARIOUS MICROCLIMATIC CONDITIONS (U)
AUTHOR G.V. Barvo and I.F. Saskov
REPORT CIS 77-497 $ FTD-ID(RS)T-1181-79
LANG Russian
AVAIL Available from DTIC as AD B046412L
SYMURL Gigiena i Sanitariya, No. 9, Pp. 60-62
DATE 0975
ABSTRACT Results of research carried out in volunteers wearing protective clothing weighing 1 to 11 kilograms in various climatic conditions (12, 23 and 45 degrees centigrade, relative air humidity 20 to 75%). On the basis of the results, relating to energy expenditures, sweat loss, pulmonary ventilation and heart rate recorded during the experiments, the authors recommended the following criteria for weight of personal protective clothing: under 7 kilograms for work of average laboriousness in conditions enabling thermal balance to be maintained; under 3 kilograms in conditions giving rise to heat stasis; up to 11 kilograms in conditions where heat removal is facilitated. (Russian)

035 TITLE COMPARATIVE TEST CHEMICAL/BIOLOGICAL (CB) DISPOSABLE OVERGARMENT (U), 54 P., (U)
AUTHOR W. Foss
CORP Tactical Air Command, USAF Tactical Air Warfare Center (Eglin AFB, FL)
AVAIL Available from DTIC as AD 916363
DATE 0174
ABSTRACT Four design models of chemical/biological protective disposable overgarments were tested for use by the Air Force. Tasks for the use of the protective garments included disaster situations, the disposal of dangerous explosives, and the overseeing of munitions loading. It as hoped that air and flight line maintenance crews would be able to perform their tasks wearing each of the four undergarments. Due to the generation of high amounts of static electricity in the nylon designs of the first and second suits, testing was limited to the analysis of the third and fourth designs. The first two garments were considered inadequate due to hazards in the design of the garments, especially the material's dange of puncturing when it was donned. The hood of the first garment tended to pull away from the inlet valves on the gas mask. The M6A2 hood unit for use with the second suit was not able to sufficiently cover the neck's opening to forestall leaks. The third and fourth garments also experienced leaks with the M6A2 hood, and none of the crews were able to successfully complete all of their tasks. Comparison of the test crew's performance indicated that design three was more comfortable to wear, but its trouser cuff drawstrings and blouse waistband gave less protection since they let air into the suit. In one instance, a solvent was able to penetrate the fabric causing skin irritation. Of the two, the fourth design was deemed to be more appropriate. As a result of the problems in design, it was recommended that none of the four desings be used as a work suit. Sample evaluation forms and photographic illustrations are included.

036 TITLE TACTICAL IMPLICATIONS OF THE PHYSIOLOGICAL STRESS IMPOSED BY CHEMICAL PROTECTIVE CLOTHING SYSTEMS (U)
AUTHOR R.F. Goldman
SYMURL 1970 Army Science Conference held at West Point, NY, June 1970, Pp. 1-15
DATE 0670
ABSTRACT Heat stress in soldiers wearing chemical protective uniforms was studied. Physical heat transfer of uniform materials was measured by flat plate techniques, protective ensembles were

evaluated on a sweating copper manikin, and predictions were validated in climatic chamber trails with volunteers marching on treadmills. Clothing systems were tested in the field in small scale studies and during field maneuvers. Results of field trails supported laboratory predictions. The tolerance limit for soldiers wearing encapsulating clothing and doing heavy work at temperatures above 75 degrees F was about 30 minutes. Men carrying heavy loads covering more ground, or in poorer physical condition were the most likely to be heat casualties. The author concludes that chemical protective uniforms severely reduce the performance of soldiers, even in temperature environments. Recommendations are given for reducing or controlling heat stress among soldiers.

037 TITLE HEAT LOAD AND WORK CAPACITY DURING USE OF PERSONAL PROTECTIVE EQUIPMENT (U)
AUTHOR S.P. Rajhman and V.V. Bubnov
REPORT CIS 77-996
LANG Russian
SYMJRL Gigiena i Sanitarija, No. 3, Pp. 41-45
DATE 0376
ABSTRACT Results of studies in volunteers performing a moderately strenous task while wearing either cotton clothing, impermeable protective clothing, or filter respirators. Heat load was assessed from the rectal and skin temperature, heart rate, work capacity, dynamic and static endurance, coordination of movements, and muscular bioelectrical activity. There was a quantitative relation between metabolic heat accumulated in the body and the physical work capacity. Changes in the latter appeared to be a major criterion for establishing work standards under the conditions studies. (Russian)

038 TITLE COMPARISON OF REACTIONS TO INDUSTRIAL PROTECTIVE CLOTHING (U)
AUTHOR N.T. Thomas, J. Spencer and B.T. Davies
SYMJRL Annals of Occupational Hygiene, Vol. 19 No. 3/4, Pp. 259-268
DATE 1276
ABSTRACT An attempt is made to assess the effects of wearing protective clothing in warm environments. The aim to provide data from which recovery times could be assessed. Normal clothing and five protective assemblies, four of which covered head and body, were tested on separate days for five cycles, each of 20 minute work and 5 minute rest. For all protective assemblies increasing heat strain followed similar patterns when measured by heart rate, body temperature and subjective assessment. With normal clothing the work/ rest schedule was adequate, but it was unsatisfactory with the protective assemblies, when times required for specified tasks also increased. Simple heart rate measurements were found to be more reliable for assessing rest requirements than any of the existing recommended Relaxation Allowances. For applications when the head must be covered, the compressed-air suit was shown to have physiological and psychological advantages over the three simpler assemblies tested.

039 TITLE PSYCHOPHYSIOLOGICAL PROBLEMS PRESENTED BY SAFETY GLASSES (U)
AUTHOR M. Krawsky
LANG French
SYMJRL Cahiers de Notes Documentaires, No. 58, 2nd Trimester, Pp. 185-193
DATE 0069
ABSTRACT Psychophysiological problems presented by safety glasses are reviewed. Topics include problems attributed to eye protection gear by users; acceptance criteria of protective gear as a function of the task; optical qualities of protective eye gear; examination of new and used glasses; and topography of the deteriorations. More durable transparency of the glasses enhances the visibility at the work site and influences the users' safety and job performance.

040 TITLE INTERNATIONAL CONFERENCE ON BIOPHYSICS AND PHYSIOLOGICAL EVALUATION OF PROTECTIVE CLOTHING (U), 16 P., (U) (Conference proceeding)
AUTHOR U. Danielsson
CORP Foersvarets Forskningsanstalt (Stockholm, Sweden)
REPORT FOA-C-54054-H1
ORIGIN Sweden
LANG Swedish
AVAIL Available from NTIS as PB84-176346
DATE 0384
ABSTRACT The Conference was held in July 4-8 in Lyon, France. The main subject of the conference was the impact of, and protection against convantional -as well as non-conventional weapons. The effect of wearing protective clothings and working capacity was discussed and to some extent the problem of trading risk of CB-or fragment casualties for decreased combat efficiency. The development of personal protective clothing was discussed at the same time as a need of new test methods was expressed. Methods for evaluation of protective clothings with respect to combat within the comfort-zone, as well as the physiological strain beyond it.

041 TITLE C-SKYDD OCH EFFEKTIVITET I FAELT (CW-PROTECTION AND COMBAT EFFICIENCY) (U), 28 P., (U)
AUTHOR U. Danielsson
REPORT FOA-C-54049-H1
ORIGIN Sweden
LANG Swedish
AVAIL Available from NTIS as PB83-241091
DATE 0083
ABSTRACT This literature study deals with the effects on various military activities when wearing individual protection against chemical warfare (CW) A complete chemical warfare protective gear, i.e., mask, overgarment, gloves, and boots, reduces the combat efficiency. The reason is (1) Heat stress, which will be pronounced in particular if the combat uniform is used beneath the CW-protective gear. In order to prevent heat exhaustion, the time for accomplishing a heavy task must increase 2-6 times compared with the expected time when wearing only the normal combat uniform. The CW-protective overgarment alone will cause a heat stress, which is comparable with that of the ordinary combat uniform. (2) Reduced manual dexterity and mobility due to wearing gloves and boots. (3) Restricted communications (vision and hearing) due to mask design. (4) Reduced work capacity due to the air resistance of the protective mask, dehydration, and reduced energy supply.

042 TITLE EVALUATION OF CHEMICAL PROTECTIVE FACELETS AND COMPARISON OF FOUR PROTOTYPES (U), 21 P., (U)
AUTHOR W.A. Lotens
CORP Institute for Perception RVO-TNO, Soesterberg (Netherlands)
REPORT IZF-1980-15 $ TDCK-75013
ORIGIN Netherlands
LANG Dutch, English Summary
AVAIL Available from NTIS as N82-15784
DATE 0080
ABSTRACT In a controlled field experiment four prototypes of chemical protective facelets were tested to determine the effect on physical and mental performance, and the chemical protection and ergonomic properties. Wearing facelets decreases the physical performance on running 400 m resp. 3 km by 3.5 resp. 7.5 percent. When worn during 24 hr. physical performance is variable and mental performance decreases by ca. 10 percent. There is no indication for adaptation within a one-week period. Chemical protection is sufficient for all four types after a while of wearing, however, one of four is highly sensitive for

rain. Ergonomic tests show only slight differencies between the facelets but there is a marked difference in comfort. Because of this the subjects preferred two types above the other two. Protection during sleep is far from optimal.

043 TITLE PROJECT FIRES; VOL. 4, PROTOTYPE PROTECTIVE ENSEMBLE QUALIFICATION TEST REPORT, PHASE 1B (U), 127 P., (U)
AUTHOR F.J. Abeles
CORP Grumman Aerospace Corp., Advanced Development Dept. (Bethpage, NY)
REPORT NASA-CR-161532
AVAIL Available from NTIS as N80-32099
DATE 0580
ABSTRACT The qualification testing of a prototype firefighter's protective ensemble is documented. Included are descriptions of the design requirements, the testing methods, and the test apparatus. The tests include measurements of individual subsystem characteristics in areas relating to both physical testing, such as heat, flame, impact penetration and human factors testing, such as dexterity, grip, and mobility. Also, measurements related to both physical and human factors testing of the complete ensemble, such as water protection,, metabolic expenditures, and compatibility are considered.

044 TITLE DEXTERITY AFFORDED BY CW PROTECTIVE GLOVES (U), 33 P., (U)
AUTHOR P.V. Vittorio and S.W. Cattroll
CORP Defense Research Establisment Ottawa (Ontario)
REPORT DREO-TN-75-21
ORIGIN Canada
AVAIL Available from DTIC as AD A017654
DATE 1075
ABSTRACT The effects on manual performance of an experimental canadian CW protective glove and US and UK CW protective gloves were compared using five different manual tasks. The results show that, statistically, performance in three of the manual dexterity tasks was significantly better with the US CW protective glove than with the Canadian or the UK CW protective gloves and in the same three tasks there was not significant difference in performance between the latter two gloves. Although the difference shown is statistically significant, its practical effect in the performance of military tasks may not be great.

045 TITLE INFLUENCE OF PROTECTIVE CLOTHING ON HUMAN STRESS IN WORK UNDER EXPOSURE TO THERMAL RADIATION (U)
AUTHOR R. Hartting and T. Hettinger
SYMJRL Arbeitsmedizin sozialmedizin Praeventivmedizin, 1984, Vol. 19 No. 1, Pp. 9-14
DATE 0084
ABSTRACT Four different types of working clothes: a normal working suit, a melter's suit and 2 different aluminised heat protective suits were tested to measure the effects upon humans working in normal room temperatures and in a room with heat radiation of 750 watts per square meter. Results show that in normal room temperatures the effect depend on the weight of the suits while in hot conditions the heat protective suits were most effective.

046 TITLE INNOVATIVE TEST OF PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF NBC AND EXTENDED OPERATIONS ON MECHANIZED INFANTRY SQUADS (SHORT TITLE: INFANTRY P2NBC2) (U), 148 P., (U)
AUTHOR K.J. Posen, G.W. Mitchell, I. Munro and J.W. Satterthwaite
CORP Army Infantry Board (Ft. Benning, GA)
AVAIL Available from DTIC as AD B101365L
DATE 0486

047 TITLE COMPARATIVE VISUAL PERFORMANCE WITH ANVIS (AVIATOR'S NIGHT VISION IMAGING SYSTEM) AND AN/PVS-5A NIGHT VISION GOGGLES UNDER STARLIGHT CONDITIONS (U), 23 P., (U)

AUTHOR II Miller R.E., W.F. Provines, M.G. Block, J.W. Miller and T. Tredici
CORP AF School of Aerospace Medicine (Brooks AFB, TX)
REPORT USAFSAM-TR-84-28
AVAIL Available from DTIC as AD B086902L
DATE 0884

048 TITLE FACTORS LIMITING ENDURANCE OF ARMOR, ARTILLERY, AND INFANTRY UNITS UNDER SIMULATED NBC CONDITIONS (U), 15 P., (U)
AUTHOR I. Munro, T.M. Rauch, W.J. Tharion, L.E. Banderet and A.R. Lussier
CORP Army Research Institute of Environmental Medicine (Natick, MA)
REPORT USARIEM-M-18/86
AVAIL Available from DTIC as AD A165865
DATE 0386
ABSTRACT The war of the future will require 72-hour operations in environments contaminated with nuclear/biological/chemical (NBC) agents. The 1985 P2NBC2 (physiological and psychological effects of NBC and extended operations on combined ars crews) program assessed solider endurance and performance under simulated NBC conditions. A total of 175 soldiers were observed during four tests differing in design, site, climatic conditions, and performance demands. In all but one of the iterations where the full chemical protective ensemble (MOPP 4) was used without cooling, soldier endurance fell far short of the projected requirement. Psychological data were analyzed to determine which factors were associated with the incidence of casualties. The findings showed that perceived intensity of symptoms resembling the hyperventilation syndrome was significantly greater in soldiers classified as casualties. Five of these symptoms (painful breathing, difficulty breathing, shortness of breath, headache, and nausea) showed casualty-survivor differences in all tests. Symptom intensity was attributed to two factors. (1) External conditions. Thermal stress exacerbated the five basic symptoms, induced others (tetany and paresthesia), and decreased endurance. Periodic relief from respirator use attenuated these symptoms and enhanced endurance. (2) Individual differences. Significant casualty-survivor differences in anxiety, depression, and cognitive strategy scores indicated that perception of hyperventilation symptoms and endurance were related to personality variables. Hyperventilation symptoms could incapacitate the soldier or induce removal of the protective mask under actual chemical attack.

049 TITLE EFFECTS OF FATIGUE FROM WEARING THE AN/PVS-5 NIGHT VISION GOGGLES ON SKILLS INVOLVED IN HELICOPTER OPERATIONS (U), 49 P., (U)
AUTHOR G.D. Chastain and A.L. Kubala
CORP Human Resources Research Organization (Alexandria, VA)
REPORT HUMRRO-FR-WD-TX-78-18 $ ARI-RR-1217
AVAIL Available from DTIC as AD A075426
DATE 0779
ABSTRACT Reviews of the literature on rotary wing flight and interviews with aviators were conducted to determine which helicopter tasks and maneuvers are performed most frequently and/or are the most critical. Those operations found to be most critical were analyzed into perceptual and psychomotor components, and a battery of perceptual and psychomotor tests was selected to measure these factors. Aviators were tested both before and after flying with the AN/PVS-5 goggles. Eye-hand coordination was marginally affected following flight, and reaction time to lights was significantly affected.

050 TITLE EFFECT OF FLIGHT GLOVES AND METHOD OF DATA ENTRY ON SPEED AND ACCURACY OF POSITIONING THUMBWHELL SWITCHES (U), 19 P., (U)
AUTHOR D.W. Plath and P.E. Kolesnik
CORP Autonetics (Downey, CA)

REPORT T5-900/3111 $ IDEP 347.90.00.00-C1-02
AVAIL Available from DTIC as AD 468881
DATE 0565
ABSTRACT The purpose of this study was to evaluate the speed and accuracy with which latitude and longitude coordinate information can be entered into a computer by use of a thumbwheel switch unit. More specifically, it was to determine the effect of flight gloves on thumbwheel operation, and to compare two methods of using thumbwheels for entering coordinates. In the first method, one thumbwheel unit was used to enter both latitude and longitude of a given checkpoint before proceeding to all the coordinates of the next checkpoint. In the second method, all latitude coordinates were entered sequentially, after which all longitude coordinates were entered in a similar manner. This method simulated the use of two thumbwheel units -one for latitude and one for longitude.

051 TITLE EFFECT ON MOTOR PERFORMANCE OF ACUTE VENOUS IMPEDIMENT AND MUSCULAR TENSION (U)
AUTHOR T.D. Hanna
CORP Naval Air Engineering Center, Aerospace Crew Equipment Lab. (Philadelphia, PA)
REPORT 451
AVAIL Available from DTIC as AD 253927
DATE 0461
ABSTRACT Because of the fatigue and decreased efficiency resulting from wearing various aviation protective gear on prolonged flights, the following study was conducted. Two measures of stress (1) static muscular tension, and (2) brachial venous impediment were used to evaluate various aspects of motor performance. Two degrees of each of these two stress conditions were employed. The results show that manual dexterity is deleteriously affected by all stress conditions, while fine weight discrimination and rapidity of sustained finger movement were not so affected. A significant increase in heart rate was observed to accompany every stress condition.

052 TITLE MAINTENANCE OPERATIONS IN A CHEMICALLY CONTAMINED ENVIRONMENTS (U), 88 P., (S)
AUTHOR D.L. Welch
CORP Andrulis Research Corp. (Bethesda, MD)
REPORT DPG-S-82-502
AVAIL Available from DTIC as AD C031036L
DATE 0283

053 TITLE EFFECTS OF CHEMICAL ATTACK ON TACTICAL STAGING OPERATIONS (U), 236 P., (S)
AUTHOR K.S.K. Chinn
CORP Army Dugway Proving Ground (UT)
REPORT DPG-S-81-501
AVAIL Available from DTIC as AD C029783L
DATE 0681

054 TITLE USACDEC OBSERVATIONS AND MILITARY JUDGMENTS (U), 9 P., (S)
CORP Army Combat Developments Experimentation Command (Ft. Ord, CA)
AVAIL Available from DTIC as AD C006105L
DATE 0376

055 TITLE COMBAT EFFICIENCY -THE EFFECT OF INDIVIDUAL NBC PROTECTION ON PERFORMANCE (U), 57 P., (C)
AUTHOR P.L. Evans and R.R. Hunt
CORP Chemical Defense Establishment Porton Down (England)
REPORT CDE-FTR-39 $ DRIC-BR-50834
AVAIL Available from DTIC as AD C951874L
DATE 0675

056	TITLE	EFFECT OF INDIVIDUAL NBC PROTECTION ON THE PERFORMANCE OF INFANTRY (U), 75 P., (C)
	AUTHOR	R.R. Hunt and P.L. Evans
	CORP	Chemical Defense Establishment Porton Down (England)
	REPORT	CDE-FTR-46
	AVAIL	Available from DTIC as AD C950129L
	DATE	0574
057	TITLE	SUBJECTIVE REPORTS ON THE EFFECTS OF NBC PROTECTIVE CLOTHING ON MILITARY DUTIES AND EVERYDAY ACTIVITIES PRELIMINARY REPORT (U), 75 P., (U)
	AUTHOR	L.E. Magee
	CORP	Defense and Civil Inst of Environmental Medicine Downsview (Ontario)
	REPORT	DCIEM-84-R-32
	AVAIL	Available from DTIC as AD C036156
	DATE	0884
058	TITLE	REPORT ON TRIAL NUMBER DCGE/DREO 2/71; PT. 1, THE EFFECTS OF CANADIAN CW PROTECTIVE CLOTHING ON THE PERFORMANCE OF INFANTRY ACTIVITIES (U), 75 P., (C)
	AUTHOR	J.O. Sturk
	CORP	Defense Research Establishment Ottawa (Ontario)
	REPORT	DREO-684
	AVAIL	Available from DTIC as AD 527514L
	DATE	0873
	ABSTRACT	Canadian CW Protective Coveralls were worn by one hundred men for three full weeks in a troop test in August 1971. The effects of wearing the CW ensemble on the performance of certain measurable infantry activities, compared with performance when wearing normal combat clothing, were evaluated according to the NATO Triptique for Permeable Protective Clothing. In those cases where the degradation in performance caused by the CW Coveralls was statistically significant, it was still within the limits specified by the Triptique. Samples of Coveralls worn for one, two and three weeks were obtained for subsequent determination of residual chemical protection. Informatin on CW Overshoes and Gloves, as well as the Coverall, was obtained.
059	TITLE	MISSION DEGRADATION RESULTING FROM CHEMICAL PROTECTIVE POSTURES (U), 99 P., (C)
	AUTHOR	K.A. Krieger, A.F. Haney and P.R Cleveland
	CORP	Pennsylvania U. (Philadelphia, PA)
	AVAIL	Available from DTIC as AD 381959L
	DATE	0467
060	TITLE	COMBINED EFFECTS OF SLEEP LOSS AND NBC CLOTHING UPON SOME ASPECTS OF MILITARY PERFORMANCE (U), 56 P., (FOREIGN RESTRICTED)
	AUTHOR	D.R. Haslam
	CORP	Army Personnel Research Establishment Farnborough (England)
	REPORT	DRIC-BR-81854
	AVAIL	Available from DTIC as AD C951317L
	DATE	1081
061	TITLE	DEXTERITY AFFORDED BY CANADIAN GLOVES (U), 39 P., (FOREIGN RESTRICTED)
	AUTHOR	P.V. Vittorio, D.J.G. Soper and S.W. Cattroll
	CORP	Defense Research Establishment Ottawa (Ontario)
	REPORT	DREO-TN-75-4
	AVAIL	Available from DTIC as AD C003273L
	DATE	0475
	ABSTRACT	The effect on manual performance on the Canadian G.P. glove and the Canadian CW protective glove, worn with and without wool liner, were compared using five different manual tasks.

062 TITLE COST OF PRODUCTION SENSITIVITY TESTS (U), 29 P., (FOREIGN RESTRICTED)
AUTHOR A.M. Reid
CORP Army Personnel Research Establishment by Fleet (England)
REPORT APRE-4M-P/1, STUDY-R.12 $ STUDY-R.12
ORIGIN England
AVAIL Available from DTIC as AD 398456
DATE 0167
ABSTRACT This study seeks a means of assessing the effects, or influence, on his total performance of what the solider wears and carries. Sensitivity tests of particular military performance tasks were carried out in November/December 1965. the purpose of the tests was to find out how discriminating the performance tasks were: specifically, how sensitive each task was to changes in load on the man, in terms of individual performance. Comparative measures were taken on the same men carrying each of the specified loads in a designed experiment involving all of the tasks. The five tasks used were: Marching, Agility, Digging, Shooting, and Fieldcraft. These tasks were ranked in importance to infantry in the top 10 tasks of a comparable study current in the US.

063 TITLE COST OF PROTECTION, PT. 1 (U), 41 P., (FOREIGN RESTRICTED)
AUTHOR A.M. Reid
CORP Army Personnel Research Establishment Farnborough (England)
REPORT APRE-R-11/72
ORIGIN England
AVAIL Available from DTIC as AD 596824
DATE 0072
ABSTRACT The aim of the study is to develop a means of assessing individual military performance which can be used to establish the extent of the cost of protection, in terms of bodily strain and reduced performance.

064 TITLE COST OF PROTECTION, PT. 2 (U), 42 P., (FOREIGN RESTRICTED)
AUTHOR A.M. Reid
CORP Army Personnel Research Establishment Farnborough (England)
REPORT APRE-R-16/73
ORIGIN England
AVAIL Available from DTIC as AD 596825
DATE 0073
ABSTRACT The aims of the trials described in Part 2 of the Study were: (1) to determine any decrements in Military Performance when wearing particular protective assemblies and equipments, as compared with normal issue combat clothing assembly and equipment as used in conventional warfare; and (2) to assess the consequent impact on the combat effectiveness of the soldier.

065 TITLE ASSESSMENT OF THE EFFECTS OF WEARING FULL NBC PROTECTIVE CLOTHING AND EQUIPMENT ON THE MILITARY PERFORMANCE OF ALL ARMS; VOL. 1 (U), 37 P., (FOREIGN RESTRICTED)
CORP Army Personnel Research Establishment Farnborough (England)
REPORT APRE-1/73-V1
ORIGIN England
AVAIL Available from DTIC as AD 596480
DATE 0473
ABSTRACT A tactical exercise was designed so that an assessment could be made of the effects of wearing full NBC protective clothing and equipment on the military performance.

066 TITLE GROUNDCREWS TEST CHEMICAL WARFARE ENSEMBLE WITH AND WITHOUT LIQUIDCONDITIONED GARMENTS (U), 21 P., (U)
AUTHOR J.C. Miller, D.C. Boone, S.M. Rokicki, K.G. Cornum and M. Davis
CORP School of Aerospace Medicine (Brooks AFB, TX)
REPORT USAFSAM-TR-85-24

	AVAIL	Available from DTIC as AD B096285
	DATE	0685
	ABSTRACT	The F-4C combat turns were performed by three munitions and two maintenance personnel, wearing the near-term ground-crew Chemical Warfare Defense Ensemble (CWDE), with and without liquid--conditioned garments (LCG), in a moderate environment--one which imposed no external heat stress. The turns involved aircraft inspections, refueling, drag-chute replacement, and the upload of four AIM-7 (Sparrow) missiles. Ambient temperatures were about 24 C dry bulb, 22.5 C wet bulb, and 25 C black globe. Task performance times in the CWDE were not affected by LCG, and were within combat time limits. Subjective ratings of fatigue and stress hormone (norepinephrine) excretion rate were reliably reduced by LCG wear. Questionnaire ratings and responses, and the subjects' remarks, showed that the LCG concept was welcomed on the flight line. Theese tests were designed to assess certain aspects of garment wearability, and not to test thermal effects.
067	TITLE	AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE); VOL. 1, TEST REPORT (U), 700 P., (U)
	CORP	Army Combat Developments Experimentation Command (Ft. Ord, CA)
	REPORT	CDEC-TR
	AVAIL	Available from DTIC as AD B073007L
	DATE	0383
	ABSTRACT	This report presents the findings of the APACHE Test and documents the methodology and approach used during the conduct of the test. The objective and subjective data from the APACHE Test will be used by the Army Aviation Center, Army Chemical School and Army Materiel Systems Analysis Agency to support assessment of aviation chemical operations, assist in development of doctrine, and in making force development recommendations. A general trial scenario is listed and data summaries presented.
068	TITLE	AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE); VOL. 2, TEST REPORT (U), 700 P., (U)
	CORP	Army Combat Developments Experimentation Command (Ft. Ord, CA)
	REPORT	CDEC-TR
	AVAIL	Available from DTIC as AD B072964L
	DATE	0383
069	TITLE	EVALUATION OF COMBAT VEHICLE GUNNER PERFORMANCE WITH VARIOUS COMBINATIONS OF NBC (NUCLEAR, BIOLOGICAL, CHEMICAL) PROTECTIVE APPAREL: A LABORATORY STUDY (U), 73 P., (U)
	AUTHOR	R.A. Lee, M. Glumm and M. Singapore
	CORP	Army Tank-Automotive Command (Warren, MI)
	REPORT	RACOM-TR-12714
	AVAIL	Available from DTIC as AD B072814L
	DATE	0383
070	TITLE	FOLLOW-ON OPERATIONAL TEST AND EVALUATION (FOT&E) CHEMICAL WARFARE DEFENSE EQUIPMENT (CWDE) (U), 103 P., (U)
	AUTHOR	D.L. Whitley, B.K. Hinton and G.W. Noga
	CORP	Air Force Airlift Center (Pope AFB, NC)
	AVAIL	Available from DTIC as AD B072065L
	DATE	0283
071	TITLE	AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE) (U), 184 P., (U)
	CORP	Army Combat Developments Experimentation Command (Ft. Ord, CA)
	AVAIL	Available from DTIC as AD B068081L
	DATE	0782
072	TITLE	DEFENCE TRIAL 6/425: PERFORMANCE OF INFANTRY SOLDIERS WEARING NBC CLOTHING IN HOT/HUMID AND HOT/DRY CLIMATES (U), 49 P., (U)

AUTHOR R.I. Tilley, H.D. Crone, B. Leake, R.I. Reed and V. Tantaro
CORP Materials Research Labs. (Ascot Vale, Australia)
REPORT MRL-R-826
AVAIL Available from DTIC as AD B065772L
DATE 0781

073 TITLE PRELIMINARY ASSESSMENT OF THE EFFECTS OF CB PROTECTIVE ENSEMBLES MOPP IV POSTURE ON THE PERFORMANCE OF SEDENTARY AND MODERATELY ACTIVE SOLDIERS IN A TROPICAL ENVIRONMENT (U), 53 P., (U)
AUTHOR W.E. Hanlon, R.D. Jones and R.P. Merkey
CORP Human Engineering Lab. (Aberdeen Proving Ground, MD)
REPORT HEL-TN-5-82
AVAIL Available from DTIC as AD B065600L
DATE 0582

074 TITLE GROUND CREW CHEMICAL DEFENSE EQUIPMENT PERFORMANCE (TASK-TIME DEGRADATION TEST) (U), 65 P., (U)
AUTHOR T.J. Cox, A.R. Jeffers and T.J. Mascarella
CORP Aernautical Systems Div. (Wright-Patterson AFB, OH)
REPORT ASD-TR-81-5003
AVAIL Available from DTIC as AD B057406
DATE 0581
ABSTRACT This report documents the results of a relatively short but intensive effort to: determine how much longer it takes ground crew personnel to accomplish combat quick turnaround tasks (F-4E aircraft) as a result of wearing their chemical warfare protective ensembles; identify potential equipment improvements; and identify possible procedure changes.

075 TITLE MATHEMATICAL MODELING OF PERSONNEL DEGRADATION; VOL. 1, BACKGROUND INFORMATION AND THEORY (U), 76 P., (U)
AUTHOR J.D. Claiborne
CORP AMAF Industries, Inc. (Columbia, MD)
REPORT ARCSL-CR-79071
AVAIL Available from DTIC as AD B043547L
DATE 1279

076 TITLE MATHEMATICAL MODELING OF PERSONNEL DEGRADATION; VOL. 2, PROGRAM DESCRIPTION FOR PDGRAM (PERSONNEL DEGRADATION MODEL) (U), 102 P., (U)
AUTHOR J.D. Claiborne
CORP AMAF Industries, Inc. (Columbia, MD)
REPORT ARCSL-CR-79072
AVAIL Available from DTIC as AD B043548L
DATE 1279

077 TITLE SEARCH FOR AN OPTIMUM FORWARD OBSERVER (FO) MESSAGE-ENTRY DEVICE (U), 58 P., (U)
AUTHOR C.R. Hughes and A.H. Keiser
CORP Human Engineering Lab. (Aberdeen Proving Ground, MD)
REPORT HEL-TM-19-77
AVAIL Available from DTIC as AD B020476
DATE 0577
ABSTRACT A human factors test was conducted during development testing of the engineering development version of the Magnavox digital message device (DMD). The measurements obtained were used to evaluate software improvements (such as default values) on the DMD and were compared with measurements obtained for previous forward observer devices such as the fixed-format message-entry device (FFMED). Operator performance was measured under lighted, dark, gloved and gas-masked conditions. The measures were obtained under conditions approaching worst case due to the relative frequency of the formats used and other test conditions. Results indicated that operators could compose and transmit messages on the DMD in less than 60 seconds if 2 hours of hands-on training was provided. With one exception (i.e., dark-gloved condition), operation of the DMd under any condition

was not significantly different from the lighted barehanded condition. Officers and enlisted personnel performed equally well. In addition, operators were able to enter data much faster and with fewer errors than operators tested on the FFMED. The results indicated that the dynamic default values considerably reduced data-entry time.

078 TITLE ASSESSMENT OF ATMOSPHERIC DIVING SUITS -FIELD 17B.3 RESEARCH REPORT 1973/74 (U), 62 P., (U)
AUTHOR I.D. Thomas and R.L. Varlow
CORP Admiralty Underwater Weapons Establishment Portland (England)
REPORT AUWE-TN-512/74 $ DRIC BR 43830
ORIGIN England
AVAIL Available from DTIC as B001159L
DATE 0674
ABSTRACT This report presents an MOD assessment of an Atmospheric Diving Suit manufactured by a UK firm called DHB Construction Ltd. A series of practical trials were arranged to evaluate the underwater working potential of the diving suit, culminating in a series of manned 1000 ft (305 m) pressure chamber dives at AUWE, Portland. The results of these trials are presented and possible areas of application for this equipment are discussed.

079 TITLE EFFECT OF HEAT AND CHEMICAL PROTECTIVE CLOTHING ON COGNITIVE PERFORMANCE (U), 27 P., (U)
AUTHOR B.J. Fine and J.L. Kobrick
CORP Army Research Inst of Environmental Medicine (Natick, MA)
REPORT USARIEM-M-4/86
AVAIL Available from DTIC as AD A162001
DATE 1185
ABSTRACT This study examined the effects of heat on the sustained cognitive performance of sedentary soldiers clad in chemical protective clothing. Twenty males trained for 2 weeks on selected military tasks. Then they performed the tasks for 7-hour periods on 4 successive days in hot (32.8C., 61%rh) and normal (32.1C 35%rh) conditions, with and without protective clothing. After 4-5 hours in the heat wearing protective clothing, the cognitive performance of the group began to deteriorate markedly. By the end of 7 hrs. of heat, increases in % group error on investigator-paced tasks ranged from 17% to 235 over control conditions. Virtually all of the decrements were due to increases in errors of omission. The productivity of the group on a self-paced task (map plotting) diminished by approximately 40% from control conditions after 6 hrs. in the heat in protective clothing; accuracy of plotting was not markedly affected.

080 TITLE DEGRADATION ANALYSIS METHODOLOGY FOR MAINTENANCE TASKS (U), 172 P., (U)
AUTHOR D.W. Harris
CORP Army Military Personnel Center (Alexandria, VA)
AVAIL Available from DTIC as AD A155073
DATE 0585
ABSTRACT The modeling of performance degradation due to chemical protective clothing has become an area of increasing interest to military analysts but has been plagued by a lack of reliable data. This research effort proposes a methodology for estimating the mechanical degradation of individual soldiers when wearing this clothing. With maintenance tasks as the investigative focal point, applicable areas of work measurement, human performance, maintenance management and degradation modeling were used to develop the Degradation Analysis Methodology for Maintenance (DAMM). Using a decision model and the appropriate Army technical manual, a taxonomy for maintnenace task analysis divides individual repair jobs into task elements according to their aim and the manual manipulation required. A procedure for obtaining movement degradation values was developed and applied using

field test data. The results were then incorporate into the Ballistic Research Laboratory degraded effectiveness algorithm. DAMM constitutes an improvement over the subjective degradation estimates which predominate in current data bases and does not require costly field testing.

081 TITLE PSYCHOLOGICAL EFFECTS OF CHEMICAL DEFENSE ENSEMBLE IMPOSED HEAT STRESS ON ARMY AVIATORS (U), 34 P., (U)
AUTHOR B.E. Hamilton, R.R. Simmons and K.A. Kimball
CORP Army Aeromedical Research Lab. (Ft. Rucker, AL
REPORT USAARL-83-6
AVAIL Available from DTIC as AD A121956
DATE 1182
ABSTRACT Psychological testing was conducted with six Army aviators before and after flights in a UH-1H helicopter while wearing standard flight suits, US or UK aircrew chemical defense ensembles. Additional testing on non-flight days was conducted to provide a baseline for evaluation. Tests consisted of encode/ decode problems, math problems, logical reasoning problems, target detection problems, and a four-choice reaction time test. Tests were scored for number of attempted percent correction reaction time of correct and incorrect responses. Self reports of mood were also taken and scored. The results of the study indicated that various levels of ensemble-imposed heat stress caused orderly changes in psychological function and extended the results of laboratory investigations to the aviation setting. In addition, reactime time data showed changes in the pilot's ability to deal with 'error' situations as a function of imposed heat stress and that self reports of mood were unreliable indicators of severe heat stress.

082 TITLE EFFECT OF CHEMICAL PROTECTIVE CLOTHING AND EQUIPMENT ON COMBAT EFFICIENCY (U), 85 P., (U)
AUTHOR J.A. Rakaczky
CORP Army Materiel Systems Analysis Activity (Aberdeen Proving Ground, MD)
REPORT AMSAA-TR-313
AVAIL Available from DTIC as AD A108575
DATE 1181
ABSTRACT A need for specific, quantitative data pertaining to the degradation of individual and unit combat efficiency caused by the wearing of chemical warfare (CW) protective gear, i.e., mask, hood, gloves, overgarment, and overboots. The US Army Materiel Systems Analysis Activity (USAMSAA) has initiated a program designed to provide these data. This report describes the first portion of this program, the development of a viable data base which will enable meaningful and useful degradation data to be generated through employment of computer simulants. Computer simulations are used to evaluate doctrine, training procedures, equipment and occasionally to study current battlefield scenarios. In any future conflict there is the strong possibility that toxic chemical agents will be employed by opposing forces to achieve a tactical advantage. As a result, computer models are being modified or developed to study the effects that chemical warfare will have on military operations.

083 TITLE ADDED AIRWAY RESISTANCE AND ENDURANCE IN INTENSIVE EXERCISE (U), 31 P., (U)
AUTHOR F.W. Stemler and F.N. Craig
CORP Edgewood Arsenal (Aberdeen Proving Ground, MD)
REPORT EB-TR-76040
AVAIL Available from DTIC as AD A028290
DATE 0776
ABSTRACT The effects of added airway resistance on endurance in running on a treadmill at 7mph was tested in US Army male volunteers. Various combinations of inspiratory and expiratory resistance were provided by the following respiratory conditions: (A)

standard M17A1 protective mask, (B) modified M17 mask, (C) peripheral M9 mask, (D) M9 mask less filter, (E) mouthpiece and noseclip, and (F) bareheaded control. In a pilot study, conditions (A) and (F) were compared at two grades on the treadmill. The decrement in endurance due to condition (A) was greater at the lower grade. In series 1 and 2, the six conditions were compared at a single grade for each of nine men, including duplicate tests on three of the men. The results were consistent with the hypothesis that the decrement in endurance due to added airway resistance will be small at high and low work rates and will be maximal at some intermediate work rate. The small added airway resistance commonly found in equipment for making various respiratory measurements during exercise can cause a decrement in proportion to the size of the resistance. The results raised the question of whether, in the range of resistances of modern protective masks, the expiratory resistance is more critical than the inspiratory.

084 TITLE BRIEFING ON THE EFFECTS OF THE PROTECTIVE MASK ON INDIVIDUAL COMBAT SKILLS (U), 19 P., (U)
AUTHOR W. Montague
CORP Human Resources Research Organization (Alexandria, VA)
AVAIL Available from DTIC as AD A020142
DATE 1158
ABSTRACT The immediate and prlonged effects of wearing a protective mask on an individual soldier's combat skills were studied in relation to seven different types of performance--rifle speed, obstacle running speed, clear running speed, rifle hits, binocular target detection, unaided target detection, radio, and driving vigilance. For each activity, one or more objective job-sample tests were constructed or existing tests modified and administered in three separate exploratory studies. Results of the study conducted at Ft. Benning, Georgia with two groups of ten men each indicate (a) the immediate effect of the mask was interference with the combat activities, and (b) men did better, on the average, after they had worn the mask for five hours than they did after five hours unmasked.

085 TITLE EFFECT OF PROPOSED B-1 PROTECTIVE SMOKE HOOD ON VISUAL PSYCHOMOTOR PERFORMANCE (U), 9 P., (U)
AUTHOR M.K. Ohlbaum and A.T. Kissen
CORP Aerospace Medical Research Lab. (Wright-Patterson AFB, OH)
REPORT AMRL-TR-75-55
AVAIL Available from DTIC as AD A015733
DATE 0875
ABSTRACT Potential in-flight emergencies on contemporary aircraft include smoke in the cockpit even without patent fire. In order to avoid eye irritation, the use of a plastic hood to isolate the face of the aviator from the smoke has been proposed. Investigation of visual psychomotor performance indicates that the hood may be marginally satisfactory for very brief time periods, but completely unsatisfactory and potentially hazardous when work for five minutes or more.

086 TITLE MEASURING THE INTELLIGIBILITY OF SPEECH THROUGH THE PROTECTIVE MASK (U), 37 P., (U)
AUTHOR F. Matanzo
CORP Edgewood Arsenal (MD)
REPORT EA-TR-4343
AVAIL Available from DTIC as AD B67552L
DATE 0370

087 TITLE PHYSICAL PERFORMANCE COMPARISON OF MEN WEARING M17, M22, AND XM28 PROTECTIVE MASKS IN HOT ENVIRONMENTS (U), 17 P., (U)
AUTHOR E.G. Cummings, W.V. Blevins and C.R. Bulette

CORP Edgewood Arsenal (MD)
REPORT EA-TR-4304
AVAIL Available from DTIC as AD 853404L
DATE 0669

088 TITLE INSPIRATORY RESISTANCE AS A LIMITING FACTOR IN EXHAUSTING WORK (U), 38 P., (U)
AUTHOR F.N. Craig, H.L. Froelich and W.V. Blevins
CORP Edgewood Arsenal (MD)
REPORT EA-TR-4230
AVAIL Available from DTIC as AD 847373
DATE 1068
ABSTRACT Although the perception of an external resistance to breathing has a low threshold, men can adapt to large resistances without impairing their capacity to perform submaximal work. When the work approaches the maximal effort, performance may be impeded by the inspiratory resistances encountered in military protective masks. Inspiratory resistances and expiratory resistances were tested in four men who walked to exhaustion with the treadmill up a grade ranginf rom 10 percent to 22 percent.

089 TITLE DEXTERITY AFFORDED BY CB PROTECTIVE GLOVES (U), 41 P., (U)
AUTHOR J.M. McGinnis, C.K. Bensel and J.M. Lockhart
CORP Army Natick Labs. (MA)
REPORT USA-NLABS-TR-73-35-PR
AVAIL Available from DTIC as AD 759123
DATE 0373
ABSTRACT Three chemical and biological (CB) protective gloves were evaluated and compared to bare hands with regard to their effects on the performance of five manual tasks during 14 daily sessions. One task measured the angular force which could be exerted on a cylindrical handle. Four tasks measured finger or hand dexterity. One of these included the use of wrenches and screwdrivers. On the Torque Test, scores were highest when the butyl rubber CB protective glove was worn and lowest (only 1/3 as large) with the standard cotton CB protective glove. Performances with bare hands and with butyl gloves worn under the leather gloves were between the two extremes and were approximately equal. On all four dexterity tasks, bare hand performance was best and performance was worst when the butyl glove was worn under the leather glove. On these tasks, performances with the cotton glove and the butyl glove were very similar and differed significantly from the extreme conditions. Because of the great impairment on manual dexterity, the butyl and leather glove combination was judged unacceptable.

090 TITLE EFFECT OF SAFETY GLOVES ON SIMULATED WORK TASKS (U), 69 P., (U)
AUTHOR B.H. Weidman
CORP Army Materiel Command, Intern Training Center (Texarkana, TX)
AVAIL Available from DTIC as AD 738981
DATE 1270
ABSTRACT The increasing demand being placed on the human hand to function in new environments requires examination of how performance is affected by the required safety gloves. The objective in this research is to help determine which safety glove or glove types are best suited for particular work situations when there is a choice in the type of safety glove which will satisfy the safety requirements. The performance of ten subjects performing five simulated work tasks under five glove conditions is examined in this report. The five glove conditions consist of barehand and leather, terry cloth, neoprene, and PVC gloves.

091 TITLE METHOD OF RELATING PHYSIOLOGY AND MILITARY PERFORMANCE: A STUDY OF SOME EFFECTS OF VAPOR BARRIER CLOTHING IN A HOT CLIMATE (U), 14 P., (U)

FULL CITATIONS

AUTHOR R.J.T. Joy and R.F. Goldman
CORP Army Research Inst of Environmental Medicine (Natick, MA)
AVAIL Available from DTIC as AD 672876
SYMJRL Military Medicine, Vol. 133 No. 6, Pp. 458-470, June 1968
DATE 0068
ABSTRACT It is our intent to suggest an experimental design which will relate physiological measurements to individual and unit performance during military tasks. It may be summarized as (A) the selection of physiological variables which can be demonstrated to be closely related to clinical or subclinical casualty production, and (B) temporally relating these to the occurrences of individual ineffectiveness in terms of job, unit progress, unit mission, and environmental variables.

092 TITLE PERFORMANCE MEASURES FOR HUMAN FACTORS ENGINEERING EVALUATION OF EARL EQUIPMENT (U), 149 P., (U)
CORP Dunlap and Associates, Inc. (Darien, CT)
REPORT SSD66-332(618)
AVAIL Available from DTIC as AD 653627
DATE 0666
ABSTRACT A simple measurement design is inadequate for field testing of teams. Observations must be structured to detect separate patterns of performance across multiple variables, individual team members, and various subtasks. Human observers at the field site cannot alone record this wide range of data at the pace of team performance. Data recording equipment, particularly videorecorders, assure a more adequate and objective data collection. Performance of certain beam tasks, generally those requiring individual initiative in cordinating activity, may be significantly altered by the wearing of the protective masks. Other tasks of a repetitive drill nature may be much less affected. Even very meticulous testing during field training activity may fail (because of the 'slack time' and indirect motivations inherent in the practice environment) to reflect validly potential decrements in a tactical environment. For 105-mm howitzer crews specifically, there will probably be no consistently critical performance problems while wearing protective masks, although the team's normal pattern of oral intercommunication is definitely disrupted.

093 TITLE EFFECTS OF PROTECTIVE MASKING UPON SMOKE GENERATOR AND FUEL SUPPLY TEAM PERFORMANCE (AN ANALYSIS OF AN EXPERIMENT CONDUCTED BY THE U.S. ARMY CHEMICAL CORPS) (U), 16 P., (U)
AUTHOR R.I. Moren and W.E. Montague
CORP George Washington U., Human Resources Research Office (Alexandria, VA)
AVAIL Available from DTIC as AD 628146
DATE 0459
ABSTRACT The following conclusions apply to the daylight performance, under cool pleasant weather conditions, of teams thoroughly practiced in their jobs and experienced in wearing the mask: (1) On the average , the decrement in job performance caused by wearing the protective mask is about 5 per cent for smoke generator and fuel supply teams, though specific performance fluctutate widely about this value. (2) When the protective mask is worn for four hours on each of three consecutive working days, there is no evidence to indicate that performance decrement either increases or decreases systematically. Nor is there evidence for any systematic change in the decrement as a result of a subsequent bivouac experience involving 68 hours of masking.

094 TITLE ANALYSIS OF CHEMICAL AND BIOLOGICAL DEFENSIVE EQUIPMENT (U), 46 P., (U)
AUTHOR J.G. Colyer
CORP Air Force Armament Lab. (Eglin AFB, FL)

REPORT AFATL-TR-72-140
AVAIL Available from DTIC as AD 522182
DATE 0772
ABSTRACT The purpose of this work is to investigate the capabilities of Air Force defensive equipment to permit an Air Force installation to maintain an operational capability in a chemical or biological environment. Typical threat environments are hypothesized. The tasks which must be performed on a base are delineated. The adequacy of the various defensive equipment for use in the performance of each task is assessed. Finally, the operational suitability of individual protective equipment is evaluated, that is, does the system not only protect an individual but also allow him to complete his mission. In addition, existing information on Air Force chemical and biological defensive equipment is compiled.

095 TITLE EVALUATION OF M17 PROTECTIVE MASK MODIFIED TO ACCOMMODATE RESUSCITATION DEVICES: EFFECT ON PHYSICAL PERFORMANCE (U), 19 P., (U)
AUTHOR S.E. Jackson
CORP Edgewood Arsenal (MD)
REPORT EA-TM-115-2
AVAIL Available from DTIC as AD 486859L
DATE 0766

096 TITLE EVALUATION OF M17 PROTECTIVE MASK MODIFIED TO ACCOMMODATE RESUSCITATION DEVICES: EFFECT OF TEMPERATURE AND WORK LOAD ON USER PERFORMANCE (U), 13 P., (U)
AUTHOR S.E. Jackson
CORP Edgewood Arsenal (MD)
REPORT EA-TM-115-1
AVAIL Available from DTIC as AD 486858L
DATE 0766

097 TITLE RESPIRATORY BURDEN OF THE FIELD PROTECTIVE MASK (U), 285 P., (U)
AUTHOR W.D. Van Huss and W.W. Heusner
CORP Michigan State U., Dept. of Health and Physical Education (East Lansing, MI)
AVAIL Available from DTIC as AD 470579
DATE 0965
ABSTRACT Three experiments were undertaken to evaluate the effects of the respiratory burden of the M17 field protective mask during heavy work. Barehanded controls and additional low and high resistance modifications of the mask were also measured. Work tasks included the half-mile run, mile run, continuous treadmill run to exhaustion, standard treadmill run, and intensive interval run to exhaustion. The effects of the various respiratory conditions, warm-up, gas collection, and training upon work performance and selected physiological parameters were evaluated. The conclusions were as follows: (1) performance times in tests of short duration do not differentiate respiratory conditions; in tests of longer duration with a higher aerobic component, the performance times differentiate respiratory conditions. (2) The high respiratory resistance conditions during heavy exercise, the maximal pulse rate, respiratory rate, respiratory minute volume, oxygen intake, oxygen pulse, and in very heavy work the respiratory quotient; (3) training under high resistance conditions elicits adaptive mechanisms, as yet unidentified which reduce sensitivity to resistance conditions and enhance performance.

098 TITLE DEVELOPMENT OF A METHODOLOGY FOR MEASURING INFANTRY PERFORMANCE IN DIGGING HASTY FIGHTING POSITIONS (U), 60 P., (U) [Partial report no. 6 on Phase 2]
AUTHOR A. Gruber, J.W. Dunlap, G. Denittis, J.L. Sanders and V.W. Perry

CORP Dunlap and Associates, Inc. (Darien, CT)
AVAIL Available from DTIC as AD 467159
DATE 0665
ABSTRACT This report describes the work performed to develop a reliable method for measuring soldier performance in this task. Procedures were established for measuring performance in the task. Procedures were establishe for measuring performance in the excavation of a simulated foxhole and tested for reliability and sensitivity to differences in clothing and equipment using USAGETA Troops. Four possible test methods were evaluated and a modified test situation with an automatic data collection system is recommended for inclusion in an integrated field course to be evaluated as the next step in the research program. The method selected involves the prestressing of participants with three 100-yard dashes after which the times to excavate specified weights of earth are recorded.

099 TITLE DEVELOPMENT OF METHODOLOGY FOR MEASURING INFANTRY PERFORMANCE IN GRENADE THROWING (U), 49 P., (U) [Partial report no. 5 oh Phase 2]
AUTHOR A. Gruber, G. DeNittis, J.W. Dunlap, J.L. Sanders and V.W. Perry
CORP Dunlap and Associates, Inc. (Darien, CT)
AVAIL Available from DTIC as AD 467158
DATE 0665
ABSTRACT A three-phase research effort is underway to develop field methodology for measuring the effects of experimental clothing and equipment on the combat effectiveness of individual infantrymen. The first partial report in this series reported work performed to identify and rank the relative importance of the physical tasks performed in combat by the individual infantryman. One of the tasks which was considered by a sample of combat veterans to be important to combat success was the ability to throw hand grenades accurately in various battle situations. This report describes the work performed to develop a reliable method for measuring performance in throwing grenades at both horizontal and vertical targets. A proposed test course was established as a temporary facility and tested for reliability and sensitivity to differences in clothing and equipment using USAGETA Troops. It was determined that the tested course provided a practical and useful basis for measuring performance in the task and a modified data collection system was recommended for inclusion in an integrated course to be evaluated as the next step in the research program.

100 TITLE DEVELOPMENT OF A METHODOLOGY FOR MEASURING THE INFANTRY PERFORMANCE IN MANEUVERABILITY (U), 75 P., (U) [Partial report no. 3 on Phase 2]
AUTHOR A. Gruber, J.W. Dunlap, G. DeNittis, J.L. Sanders and V.W. Perry
CORP Dunlap and Associates, Inc. (Darien, CT)
AVAIL Available from DTIC as AD 467157
DATE 0665
ABSTRACT This report describes the work performed to develop a reliable method for measuring soldier performance in the essential ingredients of this task under conditions considered representative of combat conditions. A proposed test course was established as a temporary facility and tested for reliability and sensitivity to differences in clothing and equipment using USAGETA Troops. It was determined that the events comprising the tested course provided a practical and useful basis for measuring the maneuverability of individual soldiers. A modified data collection system is recommended for an integrated field course to be evaluated as the next step in the research program.

101 TITLE DEVELOPMENT OF A METHODOLOGY FOR MEASURING INFANTRY PERFORMANCE IN RIFLE FIRING AND RELOADING (U), 2 P., (U) [Partial report no. 2 on Phase 2]

FULL CITATIONS

AUTHOR A. Gruber, J.W. Dunlap and G. DeNittis
CORP Dunlap and Associates, Inc. (Darien, CT)
AVAIL Available from DTIC as AD 466881
DATE 0665
ABSTRACT A three-phase research effort is underway to develop field methodology for measuring the effects of experimental clothing and equipment on the combat effectiveness of individual infantrymen. This report describes the work performed to develop a reliable method for measuring soldier performance in the essential ingredients of these tasks under conditions considered representative of combat conditions. A proposed method was tested using a modified Train Fire Range. Trials on the temporary facility demonstrated that the proposed system was sensitive to performance differences resulting from personal equipment worn, such as gloves and gas masks. A refined system is recommended for inclusion in a field course for evaluation in Phase 3 of the project.

102 TITLE IDENTIFICATION OF IMPORTANT TASKS OF COMBAT INFANTRY. REPORT OF RESULTS FROM A FURTHER REFINEMENT. PHASE II. DEVELOPMENT OF METHODOLOGY FOR MEASURING EFFECTS OF PERSONAL CLOTHING AND EQUIPMENT ON COMBAT EFFECTIVENESS OF INDIVIDUAL SOLDIERS (U), 64 P., (U)
AUTHOR A. Gruber, J.W. Dunlap and J.L. Sanders
CORP Dunlap and Associates, Inc. (Darien, CT)
AVAIL Available from DTIC as AD 452787
DATE 1164
ABSTRACT A three-phase research effort is underway to develop field methodology for measuring the effects of experimental clothing and equipment on the combat effectiveness of individual infantrymen. In order to develop a meaningful measurement system, it was necessary to identify the physical tasks performed by infantrymen in combat and to determine the relative contribution of the various tasks to combat success. The results of a preliminary study conducted under phase I of the project were refined using 311 veterans of U.S. Army operations in Vietnam, Korea, and both the European and Pacific theaters during the World War II. The veterans independently rated the relative importance of 27 selected combat tasks using a triad comparison technique. The sample of individuals were screened for relevancy of their combat experience, (and for the self-consistency and sensitivity of their ratings, leaving a final sample of 208 highly qualified raters. A high degree of agreement was found among veterans from the same and from different theatres and a reliable ranking of the relative importance of 27 definable combat tasks was established.

103 TITLE DEVELOPMENT OF A METHODOLOGY FOR MEASURING EFFECTS OF PERSONAL CLOTHING AND EQUIPMENT ON COMBAT EFFECTIVENESS OF THE INDIVIDUAL FIELD SOLDIER (U), 119 P., (U)
AUTHOR A. Gruber, J.W. Dunlap and G. DeNittis
CORP Dunlap and Associates, Inc. (Darien, CT)
AVAIL Available from DTIC as AD 429887
DATE 0264
ABSTRACT Recent developments in conventional and exotic weapon systems are creating urgent needs for new types of protective clothing and devices. While this protection may enable the soldier to survive in an otherwise fatal environment, it imposes certain physical, physiological, and psychological stresses and limitations such that his ability to protect himself against other weapons, to move, or to take aggressive action may be severely limited. The ultimate goal of the project is a field measurement system that will provide objective data regarding the effects of personal clothing and protective equipment on the combat effectivness of the individual infantry soldier.

104 TITLE TEST FLIGHT OF PILOTS' FLASHBLINDNESS HELMETS, GOGGLES, GLASSES AND ASSOCIATED SYSTEMS (U), 28 P., (U)
AUTHOR E.P. Jacobs
CORP Naval Air Test Center (Patuxent River, MD)
REPORT NATC-ST35-40R-63
AVAIL Available from DTIC as AD 414688
DATE 0863
ABSTRACT Explosively actuated flashblindness protective helmet and goggles and associated systems were evaluated in laboratory and flight tests to determine comfort, wearability,, and effect on a pilot's capability to perform his mission. The ELF lens and electrical control unit components were not satisfactory for service use. The lens evidenced poor dimensional control and was subject to leakage; failures of electrical contact unit occurred. Other components were satisfactory. The helmet size range was inadequate; an extra large size helmet is necessary for proper fitting of some objects. Other deficiences reported should be corrected and the modified equipment be submitted for evaluation.

105 TITLE OPERATIONS IN A TOXIC ENVIRONMENT (U), 160 P., (U)
CORP Army Combat Developments Command, Experimentation Commar (Ft. Ord, CA)
REPORT USACDCEC-60.3
AVAIL Available from DTIC as AD 392322
DATE 0468
ABSTRACT The report evaluates the effects of ABC toxic-protective mask, hood, and gloves on: (1) the target-detection and fire-adjustment performance of artillery and mortar forward ground observers who are wearing the toxic-protective equipment; (2) the fire-effectiveness of a 7-man Basic Infantry Element while the 7 men are wearing the toxic-protective equipment. The report is based on two experiments that were conducted in day and night conditions, with and without the use of passive night vision devices.

106 TITLE PSYCHOLOGICAL ASPECTS ROAD BATTALION OPERATIONS IN A TOXIC ENVIRONMENT (U), 104 P., (U)
AUTHOR J.K. Arima
CORP Army Combat Developments Command, Experimentation Command (Ft. Ord, CA)
REPORT CDCEC-63-4
AVAIL Available from DTIC as AD 371768
DATE 0964
ABSTRACT This technical report covers all aspects of the psychologic evaluation which was conducted as a part of the operational capability experiment (Vol. 1). Data collected during all aspects of the experiment were used for the analysis in Section 2 of the report, Effects of Prolonged Wearing of Chemical Protective Clothing as a Function of Individual Personality Characteristics.

107 TITLE ROAD BATTALION OPERATIONS IN A TOXIC ENVIRONMENT. VOL. 1, OPERATIONAL CAPABILITY EXPERIMENT (U), 357 P., (U)
CORP Army Combat Developments Command, Experimentation Command (Ft. Ord, CA)
REPORT CDCEC-63-4-Vol.1
AVAIL Available from DTIC as AD 371766
DATE 1263
ABSTRACT This report evaluates the effects imposed by a continuous toxic chemical environment on the operational capabilities of reinforced ROAD infantry and mechanized infantry battalions whose personnel wear standard chemical protective clothing and equipment. The experiment was conducted in four phases. Individual phase in two parts, (1) Panama, to evaluate effects of a hot/humid environment, (2) Fort Ord, CA, to evaluate small arms

firing performance; and the last two phases, element and Battalion, conducted at Hunter-Liggett Military Reservation. In all phases, two different combinations of standard chemical protective clothing and equipment were worn, open suit and closed suit. Normal combat clothing was also worn as a basis for performance comparison.

108 TITLE EFFECTS OF WEARING THE CBR PROTECTIVE MASK UPON THE PERFORMANCE OF SELECTED INDIVIDUAL COMBAT SKILLS (U), 37 P., (U)
AUTHOR W.E. Montague, R.D. Baldwin and A.H. McClure
CORP George Washington U., Human Resources Research Office (Alexandria, VA)
REPORT HUMRRO-TR-57
AVAIL Available from DTIC as AD 220171
DATE 0659

109 TITLE TACTICAL CHEMICAL-BIOLOGICAL OPERATIONS STUDY; ADDENDUM STUDY PROJECT MANDRAKE ROOT; VOL. 1, MAIN REPORT--ANNEX A (U), 650 P., (SRD)
CORP Army Combat Developments Command, Chemical-Biological-Radiololgical Agency (Ft. McClellan, AL)
AVAIL Available from DTIC as AD 399097L
DATE 0667

110 TITLE TACTICAL CHEMICAL-BIOLOGICAL OPERATIONS STUDY; ADDENDUM STUDY PROJECT MANDRAKE ROOT; VOL. 2, ANNEXES B THROUGH E (U), 707 P., (SRD)
CORP Army Combat Developments Command, Chemical-Biological-Radiololgical Agency (Ft. McClellan, AL)
AVAIL Available from DTIC as AD 399098L
DATE 0667

111 TITLE TACTICAL CHEMICAL-BIOLOGICAL OPERATIONS STUDY; ADDENDUM STUDY PROJECT MANDRAKE ROOT; VOL. 3, ANNEXES F THROUGH H (U), 434 P., (SRD)
CORP Army Combat Developments Command, Chemical-Biological-Radiololgical Agency (Ft. McClellan, AL)
AVAIL Available from DTIC as AD 399099L
DATE 0667

112 TITLE AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE); VOL. 1 (U), 700 P., (U)
CORP Army Combat Developments Experimentation Command (Ft. Ord, CA)
REPORT CDEC-TR-83-002A
AVAIL Available from DTIC as AD B073007L
DATE 0383
ABSTRACT This report provides data to assess the degree of degradation, if any, in Attack Helicopter Team performance attributed to conducting extended combat operations while wearing the Chemical/Biological (CB) protective ensemble. The results of this Force Development Test and Experimentation (FDTE) will be used by the Army Aviation Center (USAAVNC), Army Chemical School (USACS), Army Human Engineering Laboratory (USAHEL), and Army Materiel Systems Analysis Agency (USAMSAA) to support assessment of aviation chemical operations, assist in development of doctrine, and in making force development recommendations.

113 TITLE AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE); VOL. 2, TEST REPORT (U), 556 P., (U)
CORP Army Combat Developments Experimentation Command (Ft. Ord, CA)
REPORT CDEC-TR-83-002B
AVAIL Available from DTIC as AD B072964L
DATE 0383

114 TITLE DEGRADED EFFECTIVENESS STUDIES FOR MAJOR DEVELOPMENTAL SYSTEMS AND HIGH DENSITY ITEMS (U), 46 P., (U)
AUTHOR J.J. Baldauf and C.H. Wick
CORP Army Ballistic Research Lab. (Aberdeen Proving Ground, MD)
REPORT BRL-TR-2680
AVAIL Available from DTIC as AD A160475
DATE 0985
ABSTRACT Soldier performance when operating military systems while wearing chemical protective clothing at the most protective level, Mission Oriented Provective Posture (MOPP) level IV is a vital concern to commanders. The analysis of a soldier's degraded effectiveness provides insight into the interrelationships, between these systems and the operators. Fourteen Army systems were identified by USANCA for evaluation of compatibility, these were missions for: M1E1 tank, M-3 Bradley, XM270 Multiple Launched Rocket System, M249 squad Automatic Weapon, AH64 Advanded Attack helicopter, HMMWV High Mobility Multi-Purpose Wheeled Vehicle, Grade, XM21 Chemical Monitoring System, AN/-VDR-2 Radic Set, MEDBN aid station, SINGARS, MCS and the PLRS. Twelve-hour Mission Profiles were developed from related documents for each system. Critical tasks were extracted from these Profiles and divided into their respective time-action components. The BRL Chemical Protection Degradation Model was used to evaluate the degraded effectiveness of individuals and teams performing the specific tasks at MOPPIV. Degraded effectiveness factors were tabulated for each system by task. Factors were determined for 45 different tasks. One task which affects all missions is radio communication, which is degraded to 0.30. Road movement was found to be moderately degraded (0.87) where fire missions, loading activities and instrument reading functions were degraded to approximately 0.50. It is felt that a number of modifications of equipment and redesign of the MOPP ensemble may result in improved compatibility and a number of specific recommendations are made. The results of this study provide valuable data to the battlefield commander for evaluating the penalties he must endure because his troops must wear the MOPPIV gear while performing mission critical tasks. Further, the recommendations for improvements are valuable guidelines to the material developer.

115 TITLE RESILIENCY OF AMMUNITION SUPPLY POINTS IN A PRE-DEFINED, INTEGRATED BATTLEFIELD SCENARIO (U), 121 P., (S-NOFORN)
AUTHOR M.M. Stark and J.T. Klopcic
CORP Army Ballistic Research Lab. (Aberdeen Proving Ground, MD)
REPORT BRL-TR-2609
AVAIL Available from DTIC as AD C036303L
DATE 1184
ABSTRACT This report presents the results of a subsequent analysis of the resiliency of an ASP to a pre-defined, integrated battlefield scenario using inputs already established, including examining the effects of conventional, chemical and nuclear units on eight distinct ASPs. The result includes the effectiveness of each of these ASPs subjected to this scenario, a casualty assessment for each unit, and several excursions of interest. These excursions included an assessment of the sensitivity of the baseline results to assumptions made in regard to RED targeting capabilities and how effectively personnel can operate on MOPP gear.

APPENDIX

THERMAL STRESS REDUCTION

01	TITLE	AN ICE-COOLING GARMENT FOR MINE RESCUE TEAMS (U), 19 P., (U)
	AUTHOR	M.I. DeRosa and R.L. Stein
	CORP	Bureau of Mines, Pittsburgh Mining and Safety Research Center (Pittsburgh, PA)
	REPORT	BUMINES-R1-8139
	AVAIL	Available from NTIS as PB 254 487
	DATE	0576
02	TITLE	CONTROL OF THERMAL BALANCE BY A LIQUID CIRCULATING GARMENT BASED ON A MATHEMATICAL REPRESENTATION OF THE HUMAN THERMOREGULATORY SYSTEM (U), 561 P., (U)
	AUTHOR	L.H. Kuznetz
	CORP	National Aeronautics and Space Administration, Lyndon B. Johnson Space Center (Houston, TX)
	REPORT	NASA-TM-X-58190 $ JSC-11579
	AVAIL	Available from NTIS as N77-19756
	DATE	1076
03	TITLE	USE OF A VORTEX TUBE IN SAFETY CLOTHING (U)
	AUTHOR	J.F. Ham
	SYMJRL	Archives of Environmental Health, Vol. 10, Pp. 619-623, April 1965
	DATE	0065
04	TITLE	PERSONAL COOLING WITh DRY ICE (U)
	AUTHOR	S. Konz, C. Hwang, R. Perkins and S. Borell
	SYMJRL	American Industrial Hygiene Association Journal, Vol. 35 No. 3, Pp. 137-147, March 1974
	DATE	0074
05	TITLE	ICE-COOLING GARMENT FOR MINE RESCUE TEAMS (U), 13 P., (U)
	AUTHOR	M.I. De Rosa and R.L. Stein
	CORP	Bureau of Mines (Pittsburgh, PA)
	REPORT	CIS-76-2007 $ BUMINES-RI-8133
	DATE	0076
06	TITLE	EFFECTIVENESS OF FOUR WATER-COOLED UNDERGARMENTS AND A WATER-COOLED CAP IN REDUCING HEAT STRESS (U)
	AUTHOR	G.F. Fonseca
	SYMJRL	Aviation, Space and Environmental Medicine, Vol. 47 No. 11, Pp. 1159-1164, November 1976
	DATE	0076
07	TITLE	EFFICACY OF PRESSURE SUITE COOLING SYSTEMS IN HOT ENVIRONMENTS (U)
	AUTHOR	J.H. Veghte
	SYMJRL	Aerospace Medicine, Vol. 36 No. 10, Pp. 964-967, October 1965
	DATE	0065
08	TITLE	PHYSICAL ASPECTS OF MICROCLIMATE SUITS (U)
	AUTHOR	N.B. Strydom, D. Mitchell, A.J. Van Rensburg and C.H. Van Graan
	SYMJRL	Tunnels and Tunnelling, Vol. 5 No. 5, Pp. 482-484, October 1973
	DATE	0073
09	TITLE	DESIGN AND EVALUATION OF A PERSONAL DRY-ICE COOLING JACKET (U)
	AUTHOR	J. Duncan and S. Konz
	CORP	Human Factors Society (Santa Monica, CA)
	SYMJRL	Proceedings of the Human Factors Society 19th Annual Meeting, Human Factors in Our Expanding Technology (Papers presented 14-16, 1975), Pp. 359-363, October 1975
	DATE	0075
10	TITLE	LABORATORY COMPARISON OF PORTABLE COOLING SYSTEMS FOR WORKERS EXPOSED TO TWO LEVELS OF HEAT STRESS (U), 22 P., (U)
	AUTHOR	D.M. Terrian and S.A. Nunneley
	CORP	Aerospace Medical Division (AFSC), Air Force School of Aerospace Medicine (Brooks AFB, TX)

REPORT USAFSAM-TR-83-14
DATE 0783

11 TITLE EVALUATION OF AN AIR-COOLED VEST IN REDUCING HEAT-STRESS OF SOLDIERS IN CHEMICAL PROTECTIVE CLOTHING (U)
AUTHOR N.A. Pimental, T.H. Tassinari, B.S. Cadarette, M.N. Sawka, G.N. Sexton, V.D. Iacondo and K.B Pandolf
CORP Army Research Institute of Environmental Medicine, Natick Research and Development Center (Natick, MA)
SYMJRL Aviation Space and Environment Medicine, Vol. 55 No. 5, P. 456-456, 1984
DATE 0084

12 TITLE HEAD COOLING IN WORK AND HEAT STRESS (WATER COOLED HEAD CAP FOR HEAT STRESS AMELIORATION IN SUBJECTS WORKING IN WARM ENVIRONMENTS) (U)
AUTHOR S.A. Nunneley, Jr. Troutman S.J. and P. Webb
CORP Ohio State U., Columbus OH and Webb Associates (Yellow Springs, OH) A
AVAIL Available from AIAA Technical Library
SYMJRL Aerospace Medicine, Vol. 42, Pp. 64-68
DATE 0171

13 TITLE EFFECTIVENESS OF FOUR WATER COOLED UNDERGARMENTS AND A WATER COOLED CAP IN REDUCING HEAT STRESS (U), 30 P., (U)
AUTHOR G.F. Fonseca
CORP Army Research Institute of Environmental Medicine (Natick, MA)
REPORT USARIEM-T-23/76
AVAIL Available from DTIC as AD A025216; Available from NTIS as N77-12696; Available from AIAA Technical Library
DATE 1275

14 TITLE PERSONAL COOLING SYSTEM FOR HELICOPTER PILOTS (U), 14 P., (U)
AUTHOR S.M. Reeps
CORP Naval Air Development Center (Warminster, PA)
REPORT NADC-77289-60
AVAIL Available from DTIC as AD A047649; Available from NTIS as N78-18767; Available from AIAA Technical Library
DATE 1177

15 TITLE USE OF A WETTED COVER TO REDUCE HEAT STRESS IN IMPERMEABLE CLOTHING (U), 38 P., (U)
AUTHOR J.R. Breckenridge
CORP Army Research Institute of Environmental Medicine (Natick, MA)
REPORT USARIEM-T-7/80
AVAIL Available from DTIC as AD A094322; Available from NTIS as N81-18648; Available from AIAA Technical Library
DATE 1080

16 TITLE AUXILIARY COOLING -COMPARISON OF AIR-COOLED VS. WATER-COOLED VESTS IN HOT-DRY AND HOT-WET ENVIRONMENTS (U)
AUTHOR Y. Shapiro, K.B. Pandolf, M.N. Sawka, M.M. Toner, F.R. Winsmann and R.F. Goldman
CORP Army Research Institute of Environmental Medicine (Natick, MA)
AVAIL Available from AIAA Technical Library
SYMJRL Aviation, Space and Environmental Medicine, Vol. 53, Pp. 785-789, August 1982
DATE 0882

17 TITLE EFFECTIVENESS OF FIVE WATER-COOLED UNDERGARMENTS IN REDUCING HEAT STRESS OF VEHICLE OPERATING IN A HOT WET OR HOT DRY ENVIRONMENT (U), 50 P., (U)
AUTHOR G.F. Fonseca
CORP Army Research Institute of Environmental Medicine (Natick, MA)
REPORT USARIEM-T-2/81

AVAIL Available from DTIC as AD A203469; Available from NTIS as N82-26994; Available from AIAA Technical Library
DATE 0381

18 TITLE DEVELOPMENT OF MICROCLIMATE COOLING SYSTEM FOR COMBAT VEHICLES (U), 33 P., (U)
AUTHOR V.D. Iacono, J.S. Cohen, M. Kupsinskas, D. Gorbea and J. Fratantuono
CORP Army Natick Development Center, Individual Protection Lab. (Natick, MA)
REPORT NATICK/TR-82/010 $ IPL-248
AVAIL Available from DTIC as AD A112017; Available from NTIS as N82-27989; Available from AIAA Technical Library
DATE 0282

19 TITLE EFFECTIVENESS OF ICE (WATER) PACKETS VESTS IN REDUCING HEAT STRESS (U), 44 P., (U)
AUTHOR G.F. Fonseca
CORP Army Research Institute of Environmental Medicine (Natick, MA)
REPORT USARIEM-T-3/82
AVAIL Available from DTIC as AD A117864; Available from NTIS as N82-34021; Available from AIAA Technical Library
DATE 0382

20 TITLE MICROCLIMATE COOLING FOR COMBAT VEHICLE CREWMEN (U), 14 P., (U)
AUTHOR R.F. Goldman
CORP Army Research Institute of Environmental Medicine (Natick, MA)
AVAIL Available from DTIC as AD A117156; Available fron NTIS as N82-34083; Available from AIAA Technical Library
SYMJRL Presented at the Army Science Conference, 15-18 June 1982
DATE 0682

21 TITLE EFFECTIVENESS OF WATER COOLING UNDER PROTECTIVE CLOTHING AT TEMPERATURES BETWEEN 22 C AND 55 C (U)
AUTHOR S.A. Konz, Jr. Rohles F.H. and E.A. McCullough
CORP Kansas State U., Institute for Environmental Research (Manhattan, KS)
AVAIL Available from AIAA Technical Library
SYMJRL Research Institute of National Defense International Conference on Protective Clothing Systems, Pp. 215-221
DATE 0183

22 TITLE LABORATORY COMPARISON OF PORTABLE COOLING SYSTEMS FOR WORKERS EXPOSED TO TWO LEVELS OF HEAT STRESS (U), 23 P., (U)
AUTHOR D.M. Terrian and S.A. Nunneley
CORP School of Aerospace Medicine (Brooks AFB, TX)
REPORT SAM-TR-83-14
AVAIL Available from DTIC as AD A131848; Available from NTIS as N84-12423; Available from AIAA Technical Library
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23 TITLE EFFECTIVENESS IN REDUCING HEAT STRESS OF THREE CONDITIONED-AIR COOLING VESTS WORN WITH AND WITHOUT COOLING AIR SUPPLIED TO A FACE PIECE (U), 42 P., (U)
AUTHOR G.F. Fonseca
CORP Army Research Institute of Environmental Medicine (Natick, MA)
REPORT USARIEM-T-1/83
AVAIL Available from DTIC as AD A131875; Available from NTIS as N84-12726; Available from AIAA Technical Library
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24 TITLE HEAT STRESS RELATED TO THE OPERATION OF CANADIAN FORCES AIRCRAFT -A HISTORICAL REVIEW AND POSSIBLE SOLUTION (U)
AUTHOR C.J. Brooks, A.G. Hynes, L.V. Allin and L.A. Kuehn
CORP SAFE Association (Van Nuys, CA) and Defence and Civil Institute of Environmental Medicine (Toronto, CA) U

ORIGIN Canada
AVAIL Available from AIAA Technical Library
SYMJRL Proceedings, SAFE Association, Annual Symposium, 20th, Las Vegas, NV, Pp. 91-94, December 6-10, 1982
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25 TITLE PHYSIOLOGICAL REACTIONS OF MEN USING MICROCLIMATE COOLING IN HOT HUMID ENVIRONMENTS (U)
AUTHOR A.J. van Rensburg, D. Mitchell, WH van der Walt and N.B. Strydom
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AUTHOR S.A. Nunneley and R.J. Maldonado
CORP Air Force School of Aerospace Medicine (Brooks AFB, TX)
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